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Among Our Writers

C. L. Hall's entire professional career has been as an officer of the Corps of Engineers, which he entered as a graduate of the U.S. Military Academy in 1908. Among his assignments have been duty as Dist. Engr. at Rock Island, Ill. (1927–1930); at Cincinnati, Ohio (1932–1936); and at New York, N.Y. Colonel Hall is now Division Engr., Ohio River Division, Columbus.

John Girand (U. of Va.) has been engaged in hydraulic engineering since 1927. He spent 3 years in South America investigating water supplies for reclamation projects. He has worked on a number of dams and irrigation projects in Arizona. Since 1939 his work has been exclusively engineering design for war construction.

William H. Smith, Rear Admiral (CEC) U.S.N. (M.I.T. '15) has been in the Civil Engineer Corps since 1917, in charge of many important works, including design of the Navy's first floating drydock and the N.Y. Navy Yard's 15-million-dollar expansion program. In 1943 he became Director, Planning and Design Dept., Bur. of Yards and Docks, and in addition was recently designated Chief Planning Officer of the Bureau.

Frank B. Maltby (U. of Ill., B.S. '82) was 43 when, early in 1905, he went to Panama as Division Engineer, Atlantic and Pacific Divisions, and Principal Asst. Engineer on the Canal. Until 1901 his experience had been in railroading and municipal work. For the three years preceding his Panama assignment, he had been superintendent of dredging operations on the Mississippi River from Cairo to the Gulf.

Clarence E. Blee (Stanford U. '11) has been associated with water-supply and hydroelectric projects for the past 35 years. His work has included design, construction, operation, and administration. Up to 1935 he was on the Pacific Coast, principally with private utilities. Since then he has been with the TVA, where he now is Chief Engineer.

Mark B. Owen was for 7 years commissioner of public works, Dearborn, Mich., then for 7 years an executive in charge of design and sales of municipal equipment for a N.Y. firm. The past year he was director, Research and Development Division, Society's Committee on Postwar Construction. On May 1 he became a partner in the Russell B. Moore Co. of Indianapolis, Ind.

W. A. Lawrence (U. of Calif., B.S. in E.E., '39) in 1939 was one of two seniors chosen by the General Electric Co. for work on the G. E. Test Course, and later became electrical engr. with the company. In 1941 he was commissioned an ensign, Civil Engr. Corps, U.S. Naval Reserve, and is now a lieutenant.

William S. Little (Union Col., B.S. in C.E. '28) had several surveying and designing assignments on railroad and parkway work when in 1934 he became civil engineer and surveyor for the Eastman Kodak Co. At out 1941 he joined the armed forces as Captain, Corps of Engineers. He is now a Major with the Fort Belvoir Engineer Board.

Brent S. Drane (U. of N.C. '02) has found his principal interest in water resources, from a beginning with the Geological Survey, Reclamation Service, and Puerto Rico Irrigation Service, through the past 10 years in Washington as Executive Engr., Water Resources, under the National Resources Planning Board, and as Deputy Chief of Sect., Water Div., Office of War Utilities, War Production Board.

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Corps of Engineers Plans Ohio Flood Control

Reservoirs and Channel Protection Included in Work Finished or Projected in Ohio River Basin

By C. L. Hall, M. Am. Soc. C.E.
Colonel, Corps of Engineers; Division Engineer, Ohio River Division, Columbus, Ohio

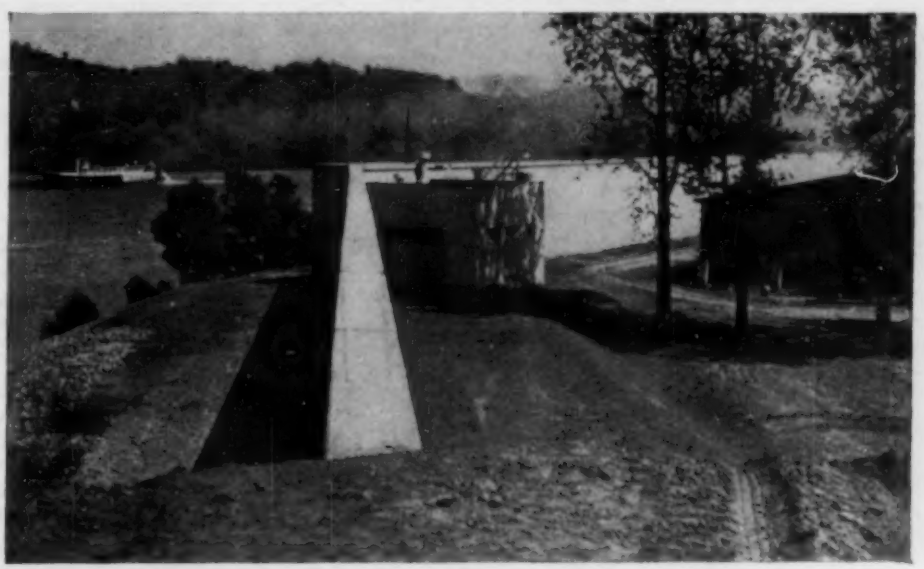
DISASTROUS floods in March 1936 and January 1937 occurred before any of the projects in the comprehensive plan for the Ohio River Basin had been completed by the Corps of Engineers. Several years later, in January 1943, after only a part of the control works had been completed, the resulting reduction in flood crest effected benefits approximating 30 million dollars. This amount represents about 75% of the total cost of the five completed reservoirs which are to be given most of the credit for the benefits. Since that time, more work has been done and more benefits realized. Colonel Hall outlines the scope of the work and the principal objectives of the basin plan in this article, extracted from his address before the Hydraulics and Waterways Divisions at the Society's Annual Meeting in New York.

THE Ohio River basin (Fig. 1) has an area of 200,000 sq miles, spreading over 13 states. The river is about 1,000 miles long from Pittsburgh to Cairo. upstream section, from Pittsburgh to Louisville, is ensively developed. This basin area above Louisle comprises only about 3% of the United States, but it are more than 12% of the employed wage earners, d more than 10% of the nation's production of manuctured goods. Flood control is of peculiar interest here cause the region certainly contains the most valuable eas of the country that are subject to periodic floods. deed it is probable that one section, downtown Pittsrgh, is worth more per acre than any other floodreatened land in the whole world.

Control of, or protection against, floods usually is acmplished by storing flood waters in reservoirs, barring h waters directly by levees and lls, or reducing flood stages by proving channels to carry an ove-normal flow. It may ocsionally be feasible to divert od flows away from highly deloped areas, and in some cases evacuate inhabitants from the od zone. The federal program flood protection in the Ohio ver basin consists of control of ws by tributary reservoirs and rect protection by levees and od walls.

Main reliance in the upper sin, above the mouth of Beaver ver, Pennsylvania, is reservoirs. e map, Fig. 1, shows the locaon of all the reservoirs in the mprehensive basin plan. Their timated cost is about half a llion dollars. In the lower basin, mage areas must be protected ainly by levees and flood walls, depending upon reduction due to reservoirs to keep the stages of greater floods below the top of protection works. The local protection projects included in the comprehensive plan involve levees, flood walls, and channel improvements. The estimated cost is $300,000,000. Figure 1 also shows the location of local protection projects. The reasons for the shift in method as we go downstream will be evident. Reservoir control is much more precise on small, compact drainage areas over which there can be no great variety of weather, and where reservoir storage effects can be accurately concentrated on some important downstream point. Pittsburgh is such a point; but Louisville is not, as storage effects cannot be concentrated there.

Channel improvement has been, and can be, used to advantage on limited reaches of some tributaries to re-



Flood Walls Protect Huntington, W.Va.

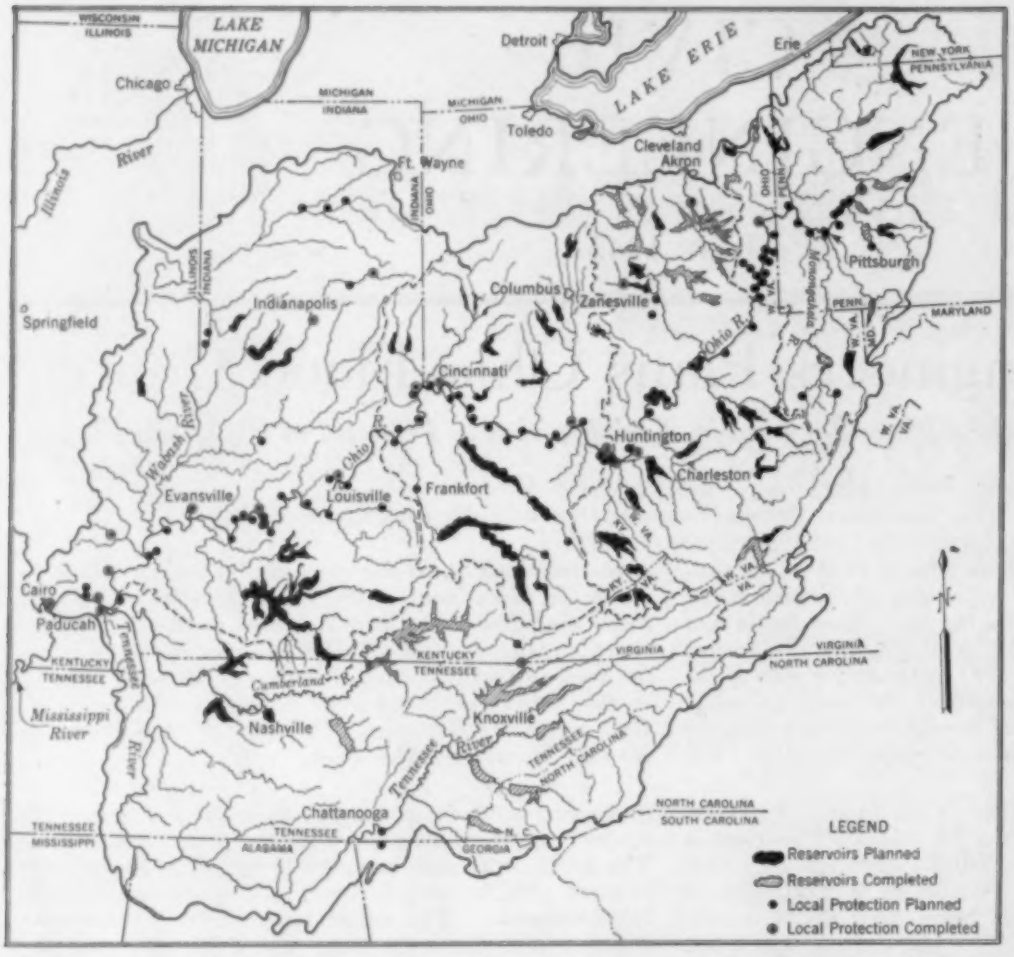


FIG. 1. OHIO RIVER BASIN, SHOWING PLANNED AND COMPLETED FLOOD CONTROL WORKS

duce flood heights through highly developed areas. As an example, the development at Johnstown may be mentioned. There is scant opportunity on the upper Ohio for diverting major flood flows from one stream basin to another. Evacuation of inhabitants from flood zones has been considered but in practically all cases is more expensive than protection.

LIMITATIONS ON RESERVOIR LOCATION

Some limitations on the location of reservoirs on the Ohio should be mentioned. In the first place the northern and western parts of the basin have been glaciated, and local topography is not generally favorable for reservoirs of generous storage capacity. In the second place, the main stem of the river is highly developed. Large reservoirs on this stem would be very effective for downstream points, but they would drown out developments above. It would be easy technically to protect Wheeling through a large reservoir below Pittsburgh, but Pennsylvania would object. So would the federal taxpayer. Hence main-stream reservoirs, such as have been used on other streams where there is no important concentration of industry, cannot be used on most of the Ohio River. Indeed, it is important on the Ohio to avoid any material effect on the flood height due to navigation dams, and the existing navigation structures have been carefully planned with this in mind.

The comprehensive plan for flood control in the Ohio River basin has had a complicated legal history. It may be sufficient to say that the Engineers estimate the cost of all the work proposed at over three-quarters of a billion dollars, and that about third of this amount has been authorized. Of the authorized portion, about half is earmarked for reservoirs and about half for local protection works.

Up to May 1, 1945, the War Department had completed, or substantially completed, 23 reservoirs. As a war measure, one of them is being operated at present primarily in the interest of industrial water supply in the important Youngstown steel district, although it has some seasonal value for the reduction of floods. Three others include storage capacity for low-water regulation in addition to that for flood control, and one reservoir will eventually involve the development of hydroelectric power. These reservoirs will control a total drainage area of about 8,600 sq miles and provide a total maximum flood control storage capacity of about 2,700,000 acre-ft. The total cost of the 23, including the cost of finishing those not yet fully completed, is approximately $119,800,000. This is about one-fourth of the cost of all the reservoirs in the federal plan. Data for the 23 reservoirs are given in Table I.

In addition to the substantially completed reservoirs, considerable work has been done on one reservoir in the Kanawha River Basin, West Virginia, and on two in the Cumberland River Basin, Kentucky and Tennessee.

The War Department has completed 21 local flood protection projects on the Ohio River and its tributaries either entirely, or to the point where they provide a substantial degree of protection. These projects are of the levee and wall, channel-improvement, and diversion types, with the levee and wall type predominating. Seventeen of them provide protection to all or parts of urban areas having a total population of about 797,000.

TABLE I. RESERVOIRS ENTIRELY COMPLETED OR IN OPERATION

NAME OF RESERVOIR	BASIN IN WHICH LOCATED	DRAINAGE AREA CONTROLLED, SQ MILES	FLOOD CONTROL STORAGE CAPACITY ACRE-FT	APPROX. COST
Tionesta	Allegheny	483	120,200	$5,200,000
Crooked Cr.	Allegheny	278	85,600	4,300,000
Mahoning Cr.	Allegheny	341	69,700	6,500,000
Loyalhanna	Allegheny	291	93,300	5,400,000
Tygart	Monongahela	1,183	278,400 (winter) 178,400 (summer)	18,500,000
Youghiogheny	Monongahela	435	242,000 (max.) 155,000 (min)	9,600,000
Berlin	Mahoning, O.	250	89,400 (max.) 10,500 (min.)	7,250,000
Mosquito Ck.	Mahoning, O.	97	33,000 (winter) 22,000 (summer)	4,641,000
14-Reservoir System	Muskingum	4,267	1,327,770	36,090,000
Dale Hollow	Cumberland	935	353,000	22,351,000

nd a property value in
he flood zones in excess
f $310,000,000. The
ther four projects pro-
ect agricultural areas
otaling about 79,000
cres. The total cost of
ll these projects, includ-
g that for finishing those
rojects not yet fully com-
leted, is approximately
39,000,000. Data for
he 21 local protection
rojects are given in
Table II.

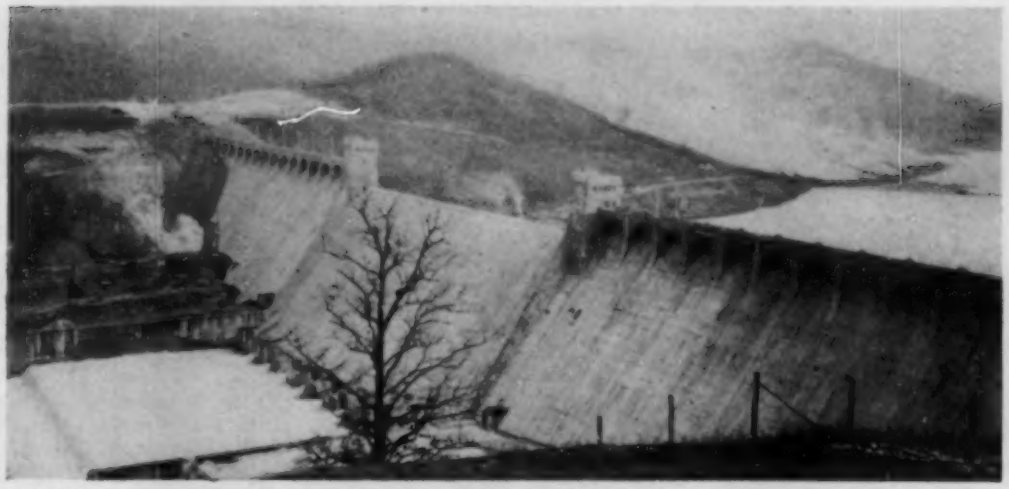
In addition, consider-
ble work has been done
n five local protection
rojects at the following
laces: Massillon, Ports-
outh, and Cincinnati,
hio; Paducah, Ky.; and Mound City,
ll. The total population of these cities is
bout 561,000 and the total value of
roperty in the flood zones to be protected
s in excess of $210,000,000.

In order to continue the orderly de-
velopment of the flood control program
nterrupted by the war, advance planning
s now under way to complete those proj-
cts which were curtailed and to under-
ake those new projects deemed the most
esirable for construction on resumption
f the program. Plans are now being
nade, in so far as the pressure of war
ork will allow, for three reservoirs now
artially completed and not yet in opera-
ion, and for 11 new reservoir projects.

Similar planning is being done to per-
nit finishing of the five existing local pro-
ection projects which are furthest from
ompletion, and to permit construction
f 10 new projects of this type.

IMPORTANT BENEFITS FORESEEN

Completion of all the authorized and
ecommended reservoirs in the compre-
ensive plan for the Allegheny and
Monongahela River basins will assure
eductions of from 5 to 14 ft at Pittsburgh
n major floods such as those of March
936, December 1942, and March 1907—
he three highest of record. It is esti-
nated that the 1936 flood stage would
ave been reduced from 46 to 32 ft, and
he 1942 and 1907 floods to a somewhat
ower stage. The reduced crest stage for
robable maximum flood conditions will
e about 36 ft. The proportion of bene-
its provided by the complete reservoir sys-
em in the Pittsburgh area is readily indi-
ated by a comparison of flood damages
etermined by survey after the March
936 and January 1937 floods. The
amage in the 1936 flood was about
53,000,000, whereas that caused by a stage
f 34.5 ft in the 1937 flood was about
4,400,000. It is apparent, therefore,
hat flood-wall protection—after comple-
ion of a reservoir system—cannot be



TYGART DAM, A MAJOR CONTROL STRUCTURE IN WEST VIRGINIA

TABLE II. LOCAL PROTECTION PROJECTS ENTIRELY COMPLETED OR PROVIDING A SUBSTANTIAL DEGREE OF PROTECTION

NAME OF PROJECT	BASIN WHERE LOCATED	TYPE OF AREA PROTECTED	TYPE OF PROJECT	APPROX. COST
Kittanning, Pa.	Allegheny	Urban	Levee	$ 100,000
Johnstown, Pa.	Allegheny	Urban	Channel improvement	8,670,000
Wellsville, Ohio	Ohio	Urban	Levee and wall	540,000
Huntington, W.Va.	Ohio	Urban	Levee and wall	7,082,000
Ceredo-Kenova, W.Va.	Ohio	Urban	Levee and wall	2,568,000
Newark, Ohio	Muskingum	Urban	Channel improvement and levee	815,000
Ironton, Ohio	Ohio	Urban	Levee and wall	2,444,000
Lawrenceburg, Ind.	Ohio	Urban	Levee and wall	2,340,000
Jeffersonville, Ind.	Ohio	Urban	Levee and wall	3,490,000
Tell City, Ind.	Ohio	Urban	Levee and wall	895,000
Evansville, Ind.	Ohio	Urban	Levee and wall	3,628,000
Golconda, Ill.	Ohio	Urban	Levee and wall	507,000
Brookport, Ill.	Ohio	Urban	Levee and wall	593,000
Brevoort Levee Unit, Ind.	Wabash	Agricultural	Levee	1,322,000
Gill Township Levee Unit, Ind.	Wabash	Agricultural	Levee	577,000
Lyford Levee Unit, Ind.	Wabash	Agricultural	Levee	267,000
White Levee Unit 8, Ind.	Wabash	Agricultural	Levee	508,000
Indianapolis, Ind. (Fall Cr. Sec., Unit 1)	Wabash	Urban	Levee and channel improvement	409,000
Muncie, Ind.	Wabash	Urban	Levee and channel improvement	662,000
Harrisburg, Ill.	Saline	Urban	Levee and wall	798,000
Middlesboro, Ky.	Cumberland	Urban	Channel diversion and levee	812,000

FLOOD OF 1936 SUBMERGED PITTSBURGH'S GOLDEN TRIANGLE

TYPICAL OF SMALL DAMS IS WILLS CREEK DAM IN OHIO

justified, because there will then be left only a small fraction of the natural damages to be protected against. A project for protection of the Golden Triangle by flood walls at an estimated cost of $4,000,000 has been authorized by Congress. Local sentiment at this time, however, seems to favor extension of reservoir control rather than enclosure of the Triangle within flood walls.

Figure 2 shows percentages of the drainage area controlled by reservoirs at various points on the Ohio River. The effectiveness of reservoir control diminishes in the downstream direction from Pittsburgh, notwithstanding the fact that the percentage of drainage area controlled is practically the same at all points. This situation is explained partly by the wider range between high and low water, and between the bankful level and the maximum flood level below Wheeling; and partly by the lesser chance at downstream points (having larger drainage areas) of rains occurring so as to utilize all the reservoirs. Table III shows the estimated reduction in the maximum flood of record at localities on the Ohio River

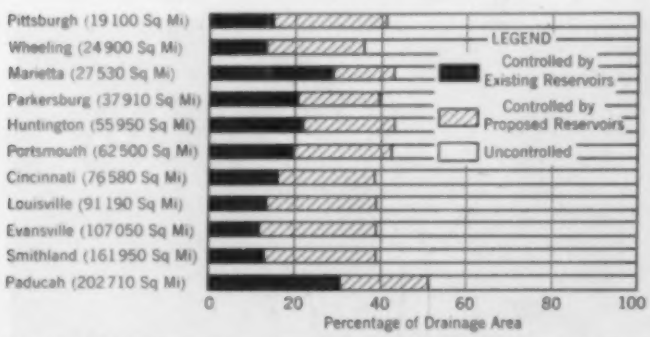


FIG. 2. CONTROL OF FLOODS ACCOMPLISHED THROUGH OPERATION OF STORAGE RESERVOIRS

under the comprehensive reservoir plan, along with other pertinent data on stages.

It is apparent from the large size of the difference between modified crest stages and flood stages, and from its corollary—the small size of the difference between the maximum and the modified stages—that dependence for adequate flood protection, in communities below Wheeling, cannot be placed on reservoirs. Hence the comprehensive plan provides for the protection of urban areas by flood walls. An investigation of project design floods for the Ohio River has shown that the comprehensive reservoir system would reduce the maximum probable flood at and below Wheeling to approximately the stage of the maximum flood of record. Accordingly, in establishing grades for the protection of urban areas, 3 ft of freeboard above the maximum flood of record has been allowed. The reservoirs, in conjunction with the allowed freeboard, will provide a margin of protection against possible floods exceeding the maximum of record.

LOCAL PROTECTION WORKS

Full consideration has been given to alleviation of local tributary flood problems. Certain supplemental reservoirs, although not productive of extensive local tributary benefits, have been included in the plan in order to provide the diversity essential to reliable basin control. Local protection works on tributaries of the Ohio River have been found to merit consideration at a number of communities on streams for which reservoir control is not practicable,

TABLE III. REDUCTIONS IN FLOOD STAGES

LOCALITY	MAX. STAGE OF RECORD	MODIFIED MAX. STAGE	FLOOD STAGE	DIFF. BET. FLOOD STAGE AND MODIFIED MAX. STAGE
Pittsburgh, Pa. . .	46.0	32	25	7
Wheeling, W.Va. .	55.2	40	39	1
Parkersburg, W.Va.	58.9	49	36	13
Huntington, W.Va.	69.4	65	50	15
Portsmouth, Ohio .	74.2	69	50	19
Cincinnati, Ohio .	80.0	75	52	23
Louisville, Ky. . .	57.1	53	28	25

for the purpose of supplementing reservoirs. A notable channel improvement is that recently completed at Johnstown, Pa., which was the scene of the great flood disaster of 1889. In this case, the channel improvement was selected after a detailed comparison with the feasible alternative of reservoir control.

Operation of the reservoir system for the Ohio basin will effect some reduction in most major floods on the Mississippi River below Cairo, since the Ohio River generally is the principal contributor to major floods at Cairo. It has been estimated that the flood discharge there in 1937 would have been reduced by 150,000 cu ft per sec had the system been in operation. Mississippi River benefits will always be incidental, because it is apparent that no sacrifice of benefits at points like Pittsburgh or Louisville will be tolerated by any reasonable man for the purpose of augmenting benefits to the lower Mississippi Valley.

Based on estimated benefits, the economic justification of the individual works included in the Ohio basin flood protection plan was established before the plan was adopted. The functioning of the completed works during the December 1942–January 1943 flood in the upper Ohio River basin proved the value of the plan, by reducing both damages and interferences in the affairs of a highly developed area. It can be anticipated that commensurate benefits will accrue as the remaining authorized works are built.

Status of the Engineer in Modern Society

Presented Before a Recent Meeting of the Arizona Section

By JOHN GIRAND, ASSOC. M. AM. SOC. C.E.

JOHANNESSEN AND GIRAND, CONSULTING ENGINEERS, PHOENIX, ARIZ.

DEPENDENCE of modern civilization on mechanized equipment might indicate that the civil engineer would occupy a relatively high place in such a civilization. As a matter of fact, few civil engineers attain the social or financial status which is enjoyed by bankers, businessmen, doctors, and lawyers. The time has come for us to make a frank appraisal of our contribution to industrial civilization.

Even the most cursory examination will reveal that the civil engineer is not responsible for the great industrial achievements of this country. The airplanes, the radios, the motor cars, the telephones, the electric ice boxes, and the prefabricated houses of tomorrow are all products of technically trained men, but their training was not in civil engineering.

This is further borne out through the law of supply and demand for the requirements of engineers, as tabulated by the Massachusetts Institute of Technology Placement Bureau. The requests that M.I.T. receives for men are in this order:

1. Mechanical engineers—58% of the total
2. Electrical engineers
3. Chemists
4. Physicists
5. Chemical engineers
6. Sales engineers
7. Metallurgists
8 (and last). Civil engineers

It is interesting to note that the demand for sales engineers exceeds that for civil engineers. In a competitive economy such as ours, the law of supply and demand operates for personnel just as much as it does for commodities, and until the demand for civil engineers increases, there seems little hope for improvement in the financial status of the engineering profession as a whole.

VALUE OF SERVICES DIFFICULT TO ASSESS

One of the principal reasons why the civil engineer is underpaid, is because the very nature of his work precludes him from realizing a profit in proportion to his skill. If a contractor, through the skillful handling of men and materials, performs a contract for less money, the savings will accrue to the contractor. For the average engineer, regardless of how well he performs his job, savings in money spent on the job will not accrue to him, but to the financing agency. The city engineer who designs a water treatment plant that saves a municipality $100,000 over a competitive design does not get the $100,000. He collects only his salary.

In many instances the value of the engineer's services cannot be assessed by the financing agency, because there is no competitive plan presented for comparison. The usual procedure is for the engineer to draw plans and specifications which the financing agency puts out for bids without calling in an independent engineer to draw another set of plans and specifications—which would give a comparison of cost between two different engineering designs. Such a comparison might make it easier for the financing agency to recognize the merits of a good engineer as compared with a mediocre engineer.

Many civil engineers are in service occupations where the value of their work is difficult to assess. Such things as stream gaging and topographic mapping cannot be reduced to a dollars-and-cents basis, so the financial advantage accruing to the country through the acquisition of this knowledge cannot be determined and passed on to those who are compiling the information.

In recent years the advantages which accrue to financing agencies through the employment of trained engineers have become a smaller factor in our economy. The deficit spending philosophy does not require engineering. When the object of the project is to spend money or give employment without regard to the economics of the project, the engineer's only role becomes that of a safety factor. A designer is required only to insure the stability, and not the economic soundness, of the structure.

During the past generation there has been a gradual shift of engineers from private employment to public employment. Government employees are notoriously underpaid, and there are many engineers now working for the government who would receive much larger salaries for doing comparable work in private enterprise.

The highest paid engineers in government work are the chief engineers in the various bureaus, such as the Bureau of Reclamation and the Public Roads Administration, whose basic salary is $8,000. These engineers are the directing heads of projects which cost hundreds of millions of dollars.

Below this top classification, which represents the ultimate the engineer can attain in public service, there are thousands and thousands of engineers in various classifications ranging from P-6 at $5,600 a year base pay down to the P-1's at $2,000 a year base pay. Any general increases in these salaries will depend to a large extent upon legislation, and so long as Congressmen receive only $10,000 a year, it can hardly be expected that they will authorize salaries for people who are working for them in larger amounts than they themselves receive.

As an example of the Congressional attitude toward salaries, the recent law passed by Congress, "The Reconversion Act of 1944," creates a Director who will supervise the reconversion of all Government war plants, the disposal of all surplus war property, and the return and reemployment of soldiers. Congress authorizes the director of this tremendous business enterprise to receive a salary of $15,000 a year. As long as this attitude toward salaries is displayed by Congress, it seems improbable that Civil Service regulations will be amended to place engineering salaries on a par with those in private firms.

Many government employees feel that in addition to their base pay they receive benefits such as sick leaves, vacations, retirement income, etc., which offset to a certain extent the lower salary received in government service. While it is generally true that government employment is more stable than private employment, and hence that the engineer employee can feel greater security, there are many agencies, not only in the Federal Government, but particularly in state, county and municipal work, where these benefits do not accrue. Surely the

security factor of jobs of this type cannot be assigned a large value.

A general increase in the salaries paid engineers can come in only two ways: either the number of engineers who must share in the total funds available for engineering must be decreased, or the total amount of funds available for engineering must increase.

RESTRICTIONS ON NUMBER

The reduction of the number of engineers has been, and is being, attempted. The state licensing laws, the stiffening of educational requirements, and the qualifications necessary to belong to a professional society are all restrictive in purpose, and regardless of the high motives attributed to such restrictions, they are essentially an economic move designed to increase the salaries of engineers by reducing the supply. The recent action of the Society with respect to the committees on collective bargaining is another step tending to separate the "sheep from the goats," further reducing the number of men who might be called "engineers," and hence increasing the proportionate share that these engineers will obtain of the total funds available.

The second method of increasing salaries for engineers involves increased appropriations. Such a move will more than likely be met with great resistance by the taxpayer, who must in the final analysis pay the bill for all engineers who are not engaged in private practice. Engineers in private practice will probably have less trouble in obtaining higher pay scales, owing to the fact that the merit of the design enters into the determination of fees to a much greater extent than in government work. An increase in appropriations can be obtained through labor union methods—strikes and coercion. These are standard policies throughout this country today to obtain pay-scale increases. Professional engineers have rejected these methods. It now remains to be seen whether this rejection will be to the advantage of engineers over a long period of time.

The resistance of engineers to the coercion movements, together with their continued insistence upon "professional standing" leads to a paradox which is not found among our professional brothers, the doctors. There are probably few labor unions in the United States that employ such severe restrictive measures as the medical associations.

Membership in the medical association is a prerequisite to the practice of medicine, and a doctor who is barred by the medical association soon finds himself in economic difficulties. Certain standards are required of the places where doctors work, the hospitals, and hospitals that do not meet these standards discover doctors are "reluctant" to use their facilities.

THE PROBLEM OF INCREASED MONETARY RETURN

If engineers adopted these tactics, a professional engineer would not work in any organization, for instance the state highway department, until the highway department had been approved by the Society, which approval would necessarily be contingent on the payment of satisfactory salaries. A private engineer would refuse to perform work except at the Society's standard schedule of fee, and the client would be unable to go to any other engineer and get the work done. The use of such coercive tactics by the Society now seems so far fetched that it is hardly worth discussion, yet if such tactics were employed it might be that engineering would develop into a profession whose members would enjoy the high social and economic standing in the community now enjoyed by doctors.

The possibility of increasing appropriations for engineering salaries seems remote when it must be considered that the taxpayer will be required in the next few years to finance not only the war, but the proposed public works, which seem to be our next step in domestic economy. Yet the prospect for the engineer is not entirely hopeless. As in all professions, generally speaking, the people who are worth more money get more money. It is well known that when the periods for layoff come, the poorest men are laid off first. All businessmen try to keep their best men as long as they possibly can, and if the financial rewards seem small, the engineer working for the government may always console himself by reading the editorial in a recent issue of *American Highways:*

"The financial return accruing to men in the public service is rarely sufficient either to attract or to hold them. There is something above and beyond this—a pride of accomplishment, a devotion to service, an ideal—values beyond mere monetary reward—that is responsible."

As a class, engineers are probably better suited to invade other fields than any group now in the United States. There are many engineers who were formerly employed by the states and government, who are now occupying responsible positions in industry, owing principally to the fact that they were discharged from their government jobs, and had to go to work in an industry that did appreciate their talents.

However, the engineer who decides to leave pure mathematics behind and face the world soon learns that his education has been sadly deficient in those factors which make it easy to get along with people. One of the large insurance companies has worked out a system for examining applicants who wish to sell life insurance for the company. Is both interesting and instructive to note that a man who puts on his application that he used to be a civil engineer is penalized three points on his examination. Briefly, the engineer lacks sales ability, and until he can sell his products he can hardly be expected to compete with aggressive industrial concerns.

COMPARISON OF WORTH DIFFICULT

What seems to be lacking is a "yardstick" that will compare the civil engineer with other groups in the United States. To try to get more money because some other group—the doctors, for example—get more money is not only selfish, but illogical. Where does the civil engineer fit into the whole picture? Perhaps the best answer is to say that the civil engineer is a part of the whole—just one limb of a large tree which will thrive and flourish only in proportion to the well-being of the whole.

If, through abuse of the privilege of professional associations, the doctors drive themselves out of business and into socialized medicine; and if, through the abuse of the rights of all men to work as they choose, labor unions bring legislative restrictions on their members, then let it be said that the engineers were able to see clearly that no group is more important than the whole. The status of the civil engineer in modern society is unsatisfactory. It is the wars and depressions and turmoil and confusion of society that cause low standards of living for engineers as well as for other groups. Yet our activities and the activities of our Society are confined principally to doing our daily task and writing or disputing an occasional technical paper. If only a part of the energies we waste in futile arguments over technicalities could be directed to constructive work to improve the status of all the people in modern society, most of our troubles would be solved.

Artificial Harbors for Normandy Beaches

Landing Facilities Provided and Manned by Seabees

By WILLIAM H. SMITH, M. AM. SOC. C.E.

REAR ADMIRAL, CIVIL ENGINEER CORPS, U.S. NAVY; DIRECTOR, PLANNING AND DESIGN DEPARTMENT, BUREAU OF YARDS AND DOCKS

HARBORS of many designs have been established in all sections of the globe by military forces in this truly global war. Most unusual of all are the artificial harbors which were built on the beaches of Normandy to receive men and materials for the invasion of the European mainland. The operations were painstakingly planned and executed, as described in this article by Admiral Smith. The paper from which this article was taken was delivered before the District of Columbia Local Section.

MODERN warfare is now a combination of all phases of activity—under water, on land, in the air, and in the stratosphere. Amphibious warfare is universal. Even the great battles fought on the western front in Europe had their inception in amphibious warfare—the invasion along the Normandy coast of France. Nothing in military history compares with the magnitude and boldness of this undertaking. Never before was an invasion undertaken against so formidable and well protected a foe.

The Normandy and Brittany coasts of France are conspicuously lacking in natural harbors—all their main ports are man-made and the result of years of effort and millions of dollars of expenditure. Naturally, as these ports were developed, their defensive features proceeded apace, and each port was defended by shore batteries so as to be practically impregnable from ocean-side attack. Similarly, the mining of approach channels and anchorages precluded the landing of an invasion force through any existing ports.

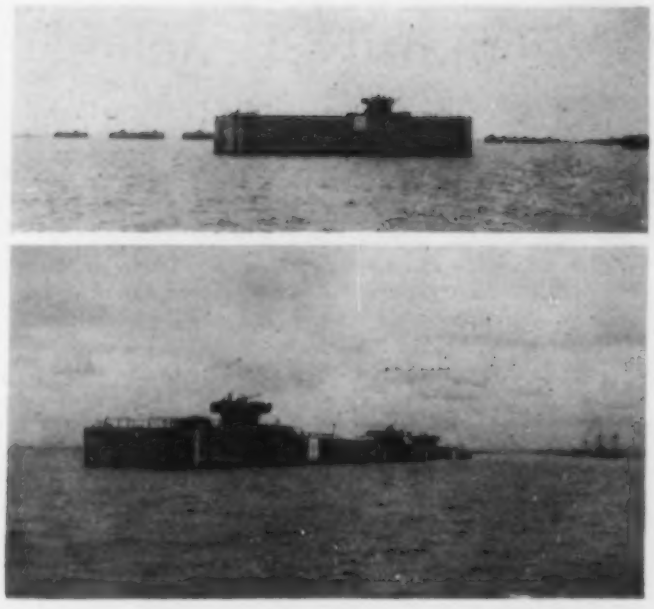
The English Channel has long been noted for its treacherous weather, and in the hundreds of years of occupancy of Normandy, no one has ventured to establish a port along these open beaches. It was for the United Nations' forces at the Quebec Conference to decide to do just that, and to do it, not over a period of years, but in days—not with the help and cooperation of the populace, but in the face of entrenched military resistance. The time of the invasion was set to give us the best period of weather, for the length of time it was estimated would be required to capture some existing ports, and place them in operation.

A method of providing protection at these beaches, or more properly, a method for developing artificial harbors, was proposed in general terms by the British delegation at the First Quebec Conference. The proposed harbor would consist of a series of breakwaters composed of elements which would be prefabricated in England, and it would be susceptible of rapid installation after being transported to the invasion beach. Behind the protection of this breakwater, the general scheme contemplated the installation of pierhead structures, called "Lobnitz pierheads," previously assembled, transported to the site, and fixed in position. These pierheads, in turn, were to be connected to the high-water line of the beach by prefabricated and assembled pontoon bridge structures. In addition, at each artificial harbor a second break-water was contemplated in shallower water primarily as a haven for small craft.

It was determined that there would be a total of five invasion beaches, of which two were to be provided with artificial harbors as previously described. The other beaches would have only the secondary breakwaters to act as havens for small craft. The American beaches were to be two in number, one of which would include an artificial harbor; the British beaches were to be three in number, of which one would include an artificial harbor.

The engineering problems consisted in providing an artificial harbor in which Liberty Ships could be moored; facilities for the discharge of LST's and small coasters directly onto piers; and a means for the steady discharge of LCT's and smaller landing craft other than through

TROOPS AND TRUCKS ASHORE DRYSHOD ON THE COAST OF FRANCE FOR THE ATTACK ON "EUROPA FESTUNG"



PREFABRICATED CONCRETE PHOENIXES WERE SUNK TO FORM A BREAKWATER

the surf. These facilities had to be provided in a minimum of time, and in spite of the infamous English Channel weather and an average tidal range of 24 ft over a beach sloping 1 ft in 150 ft.

In developing the elements to be used in the construction of the artificial harbors, various types of units to form the main breakwaters were considered; these included compressed-air breakwaters, floating ship breakwaters, sunken ship breakwaters, floating concrete caissons, and a unit known as a "Lilo," consisting of a combination of concrete structure and inflated gas bags. For the elements of the secondary breakwaters for small boat havens, the decision was quickly reached that they would consist of sunken ships.

The pierheads and connecting bridge to shore had been previously studied, and were well along in design. The study of the various types of main breakwaters resulted in the adoption of reinforced concrete caissons as the principal element in the breakwater. The "Lilo" type led to the development of a floating steel cruciform unit which was planned to be placed outboard of, and parallel to, the main caisson breakwater for the purpose of dampening surface waves and thereby providing an anchorage for larger craft outside the main artificial harbor. Obviously, such ships as were to be sunk in place in the secondary breakwaters were procured from any available source, utilizing naturally the older and poorer class of ships, including a decommissioned British battleship. The proximity of England to the invasion beaches, the relatively sh tows involved, and the impracticability of prefabric ing and shipping any of the elements from the Uni States led to the decision that all elements entering in the construction of the artifical harbors would be bu —or fabricated and assembled in a condition ready f towing—at various localities in the United Kingdo The design of the pierheads and bridging units, a of the cruciform floating breakwater units, was comple under the jurisdiction of the British. Complete desi of the concrete caisson units were prepared both by t British and by the U.S. Navy, and the latter's design w offered to the British. The design finally adopted by th was the basic British design which did, however, inc porate some of the features of the Navy design a recommendations made by the U.S. Army and Nav The final responsibility for all designs rested with t British.

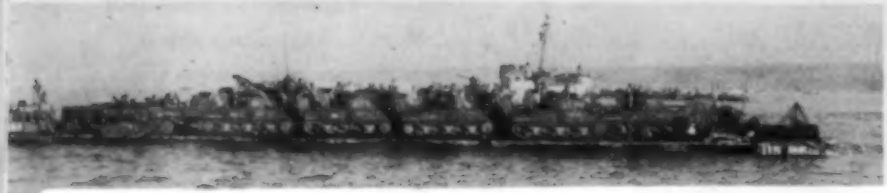
Installing the various units in the artificial harbo was under the Allied Naval Commander with a Re Admiral of the Royal Navy in direct charge. Under th general command of this officer, the installation of th various elements comprising the American beaches a artificial harbors was an American commitment to b performed by American forces. Similar arrangement prevailed regarding the British beaches and artifici harbors, with the exception that all moorings, and th installation of the cruciform type of floating breakwate at both beaches, were commitments of the British.

The manufacture of the required caisson units fo both the American and the British artificial harbor in the time remaining to meet the target date, was construction problem of a magnitude quite unusual i the United Kingdom. It was one which was bound t test their maximum effort.

Time available would not permit the development o conveyor-line production, but required almost simul taneous construction of all units. It was necessary there fore to provide construction sites, plant, and equipmen at many localities, and this unfortunately necessitate considerable duplication. Several existing dry dock were utilized as construction basins; artificial construc tion basins were prepared; and building ways an launching ways were developed at other sites to provid the requisite number, which would insure meeting th target date. Several contractors were assigned the con struction of units, each to the number that its organiz tion was able to complete within the time limit.

Special arrangements were made for the rolling of th requisite quantities of reinforcing steel, and for the re cruiting of the necessary manpower. Construction oper ations were carried on day and night, seven days a week It is a tribute to the construction fraternity of th United Kingdom that this tremendous project was car ried to completion in record time, in the face of deplete manpower and materials. Some idea of this construc tion program can be gained when it is considered tha 147 separate units, the majority of which were th equivalent of a five-story, reinforced-concrete buildin in size, were completed over a period of approximatel eight months.

Fabrication of the pierheads and bridging structure was carried on simultaneously throughout the Unite Kingdom at existing industrial plants. Extensive us was made of subcontracting on the various parts to in sure rapid completion. In the main, these structure were composed of standard structural stee shapes and plates, and special appurte nances were reduced to a minimum Each pierhead consisted of a steel barg



RHINO FERRIES CARRIED THE VAST QUANTITIES OF MATERIALS OF ALL SORTS FROM SHIP TO SHORE

LANDING CRAFT UNLOADED AT SUNKEN PONTOON CAUSEWAYS AFTER DESTRUCTION OF THE FIRST PIERS

equipped with four corner spuds, and its own power plant, so that the elevation of the barge, or pierhead, could be controlled through the operation of the spuds. The pierheads were connected to shore by fabricated Bailey-truss bridge spans supported on moored steel or concrete pontoons. The fabrication and assembly of the bridge units were similar to those of the pierheads.

The units that have been described portray the artificial harbor as originally contemplated. As plans developed and the details of the operation were studied, the extreme urgency of getting men and equipment ashore, dry shod, in the very early stages of the invasion became more and more evident. For this purpose the sunken pontoon causeway and the Rhino ferry were developed by utilizing U.S. Navy NL pontoons. The sunken pontoon causeway consisted, briefly, of a paved strip, two or four pontoons wide, extending outboard from the high-water mark to a distance beyond the low-water mark. This provided in reality a hard-surface beach or roadway extending from low-water to high-water, alongside which all types of craft, from an LCT down, could discharge their cargoes of either men or equipment at any stage of the tide. Two such causeways were planned for each beach and each artificial harbor.

Also developed for use within the harbor and at the beaches, was the Rhino ferry, composed of U.S. NL pontoons, six pontoons wide and thirty long, approximately 42 by 175 ft, equipped with two propulsion units, and with a bow ramp, which would permit unloading direct from LST's. All pontoon units and Rhino ferries were assembled at various bases in the United Kingdom by Seabees.

The training of U.S. Forces was carried on simultaneously with the manufacture and assembly of all artificial harbor units. A total of 14 training stations were built and equipped by the Seabees.

CREWS ASSIGNED TO HARBOR UNITS

Prior to D-Day, all units and personnel were assembled at various staging areas in preparation for departure to the invasion beaches. For the American beaches, the Seabees were assigned the task of riding the various units during the Channel crossing, and the actual placing in position at the beaches of the various units, as well as their operation after installation—with the exception of the sunken-ship breakwaters, which were placed and sunk in position by regular Navy forces.

The riding crew of each caisson or Phoenix consisted of six Seabees with a U.S. Army anti-aircraft unit. On arrival at the beach site, the Phoenix was transferred to a Seabee sinking crew, and the sea-going towing tugs were replaced by harbor tugs, for the sinking operation. Each Phoenix was jockeyed into final position and sunk to rest on the bottom by means of flooding valves built into the structure.

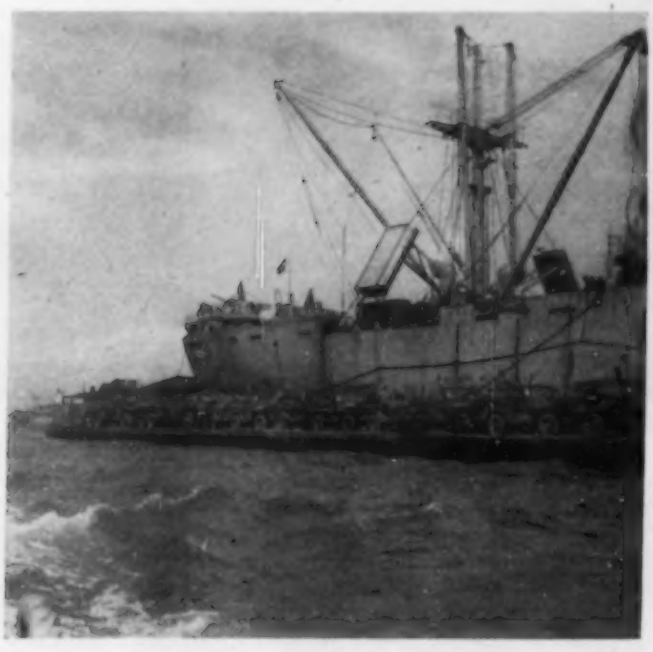
Each Lobnitz pierhead was manned by a crew of 16 Seabees who rode the pierhead during the tow, placed it in final position with the aid of harbor tugs, and operated it after placement. Sections of bridging were assembled in units of five or six spans, each with their supporting pontoons, and towed with a Seabee crew, which placed them in final position in the harbor, and formed

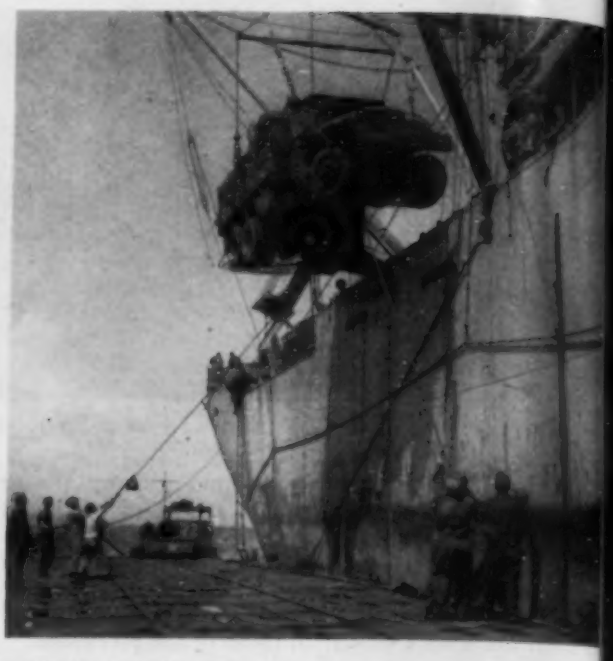
AT THE END OF THE BRIDGE TO SHORE WAS THE LOBNITZ PIER

patrol and maintenance crews after placing. Pontoon causeways were assembled in sections 175 ft in length, towed to the site, placed in position, and maintained by Seabee units. Rhino ferries were towed as units to the beach areas, and manned and operated by Seabee crews.

Beginning on D-Day, the units arrived on schedule, and despite enemy action and the excitement and varying degrees of confusion bound to exist during the early periods of an assault, the units were sited and placed on position with almost clock-like precision. In planned sequence, Phoenixes arrived on schedule, were taken in hand by the sinking crews, and with startling speed were sited and sunk in position. Similarly, the Lobnitz pierheads, bridging, and sunken pontoon causeways were positioned and set in place. The soundness of the technique which had been developed through study, experimentation, and training (during which full-sized units were handled exactly as though they were being installed in their final position) reflected itself in the smoothness of the operation and its time of accomplishment at the beaches. Similarly the placing of the sunken-ship breakwaters reflected the thoroughness of the preparations.

Rhino ferries, complete and ready for immediate operation, were towed to the far shore by LST's. Immediately on arrival, beginning with D-Day, these ferries





VIEWS OF RHINO FERRIES BEING LOADED AT SHIP SIDE

were secured to LST's. However, sea conditions on D-Day were far more severe than those encountered during the training period, when the technique for securing the Rhino ferries to the LST's was developed. Consequently, considerable difficulty was experienced in effecting those connections since darkness and enemy action were added to unfavorable sea conditions. Nevertheless, this work was carried out according to plan, if not according to the desired time schedule, and the Rhino's deposited their loads on the beaches on D-Day.

UNPRECEDENTED STORM

From D-Day, June 6, to June 19, the installation of all harbor units continued according to schedule, and the progress made was gratifying. However, on the 19th, from a direction which according to long meteorological records was entirely unexpected, a storm of great intensity arose and necessitated the discontinuance of these operations. At this time the artificial harbor was approximately 85% complete, and each unit of it (pierheads, bridging, causeways, and Rhino's) was actually operating satisfactorily. Unfortunately, the storm continued to increase in intensity to a degree far exceeding all design assumptions, and lasted for about four days.

The fury of the storm was sufficient to either sink or tear loose from their moorings all the cruciform units in the outer floating breakwater, setting many adrift and adding to existing hazards. Large numbers of all types of small craft were caught unawares. Moorings and anchors were dragged, or lines parted, setting large numbers adrift which, colliding with others, set them adrift also. There was little or no hope of retrieving any drifting craft because of the storm conditions and resulting confusion. Several units of the reinforced-concrete caisson breakwater, which were topped by the waves, and incessantly battered with floating objects and craft, were destroyed almost to the low-water line and consequently rendered ineffective as a breakwater. It is interesting to note, however, that in some instances a single unit stood out practically undamaged, while the two adjacent units were destroyed to low-water level.

Despite the mass of the Lobnitz pierheads and the sturdiness of their spuds, they were wrenched about in the storm sufficiently to tear spuds from their fittings and the pierheads were cast adrift. The long lines of bridging leading from the pierheads to the beach acted as a boom against which all manner of floating craft and objects were driven. The accumulation of floating craft increased as the storm continued, until these craft were piled in many cases one on another, high and dry above water level. This accumulation tore the bridging from its moorings, greatly distorting it, and in several instances overturning the bridge structure completely.

The pontoon causeways, besides being shifted in position, accumulated on their decks all types and sizes of drifting craft. During the fury of the storm, Rhino ferries were beached, and one was deposited in some unknown manner far above the high-water mark. Landing craft as large as LCT's were thrown on the beach completely inverted, 180 deg. When the storm ceased on June 23, the spectacle was one to try the stoutest soul. However, as the result of unceasing and heroic efforts, the moving in of supplies was resumed, utilizing any and all means, and the speed at which men, stores, and equipment passed over the beaches following the storm continued to increase at a surprising rate.

A survey of the damage led to the very sound conclusion that restoration of the original artificial harbor, as planned, would not be practicable in view of the time element involved. Superimposed upon the already huge task of getting materials ashore was the task of salvage, which, in view of the magnitude and extent of the damage, was a major one. It was decided that further operations would be carried on by beaching all landing craft, including LST's and that unloading of deep-draft vessels would continue by utilizing Rhino ferries, LCT's and smaller landing craft, with extensive use of DUWK's. The DUWK's, while relatively small, rendered very valiant service because of their speed and facility of operation whether in water or on land.

During the storm, the sunken-ship breakwater likewise was damaged. Practically all vessels, including the large British battleship, broke their backs. The continued use of large numbers of small landing craft necessitated some provision for their protection during storms, and to meet this need, the existing sunken-ship break-

ater was reinforced by the installation additional ships, and by concrete caisn units. This was done at both the merican beaches.

Following the storm, the beaches were continuous operation, and over them ere discharged men, stores, and equipent in most satisfying quantities. The hino ferries, used at both beaches in ndling motor transport from cargo ships, ere in continuous use throughout, and ndered most valuable service. Similarly, e sunken causeways were continued in gular use, handling both motor transport d personnel as received from Rhino rries, LCT's, or any other type of craft. hey were the means of placing thouands of units of equipment and tens of ousands of men ashore dry shod. The hino ferries and the causeways, because their simple basic construction, the pidity with which damaged parts can be replaced, and heir lack of cumbersome, heavy units, have proved themelves of inestimable value in operations of this kind. Outanding in their advantages are: (1) simplicity of conruction; (2) utilization of small units readily handled; 3) simplicity of assembly; (4) ease of transportation hether assembled or disassembled; (5) speed with which ey can be placed in operating position; and (6) simlicity of making repairs.

DECK OF RHINO FERRY REPAIR BARGE

REPAIR FACILITIES PROVIDED

A Rhino repair barge, composed entirely of NL pontoon units, was provided at each beach, as was a pontoon ry dock for small craft. These facilities were in conuous operation during the period of beach activities. ll Rhino's, dry docks, Rhino repair facilities, and causeays continued to be operated by Seabee units. All nstruction on the beaches and the maintenance and eration of beach camp facilities were Seabee operations.

Damage to the artificial harbor installation at the itish beach, several miles to the east of the American aches, while serious, was not as extensive as that to the merican harbor. Each harbor utilized units of the me design and manufacture, and therefore the variaon in degree of damage must be traced to other causes. hese causes undoubtedly were: (1) the fact that the itish beaches, being so far to the east of the American aches, are in the lee of the Fecamp coast line; (2) to e north and east of the British artificial harbor is the tensive area of shoal water caused by the Calvados ocks, which to a certain degree provide the advantages a protected harbor; and (3) the fact that fewer units d been installed on the British beach than on the Ameran beach, at the time the storm struck.

The conception of the artificial harbors on such a emendous scale was a bold and daring one. The actual anufacture of the various units, their transportation the site, their installation at the site, and their sucssful use in place before the storm struck, definitely oved the practicability of the project. The design as sound, and was based on the probability of a storm ore severe than recorded data indicated would occur uring the period of use of the artificial harbor. When, nfortunately, conditions were encountered far more evere than those to be expected, according to available ata, and more severe than those on which the design as based, damage was inevitable. Had the weather en such as would normally be expected throughout e summer months, the inevitable destruction of the artificial harbor by storm would not have occurred until some future date.

The boldness and daring of conception, and the carrying to completion of this tremendous operation, will long live in military history. It is interesting to note the continuous and spectacular part played by the Seabees throughout the entire project. Having constructed the training bases throughout the United Kingdom, they (leaving behind necessary maintenance and operating crews) moved on to prepare, assemble, and construct various of the elements to be used in the actual invasion. When they had assembled and constructed the Rhino ferries and causeway units, they immediately began their own training for the operation of these units, and they have continued this operation to date. When Phoenix units became available, Seabees took them over for training purposes, both in towing and sinking operations, and actually placed all units in the American artificial harbor. Incidentally, the Seabees have constructed some Phoenix units since the invasion.

From the earliest beginnings of this operation to its conclusion, the Seabees, by their versatility, have been a continuously active force, and have demonstrated their ability to justify their popular and well-deserved motto, "Can do."

In at the Start at Panama

I. My Introduction to a Tremendous Project

By the late FRANK B. MALTBY, M. AM. SOC. C.E.
EARLY DIVISION ENGINEER ON THE CANAL

MANY engineers have become acquainted with the modern Panama Canal; indeed the war has tended to intensify this familiarity. Not so much is known of its building because the principals in that early work are fast becoming legendary. One such was the late Frank Maltby, who was also something of a raconteur. Fortunately he committed many of his reminiscences to paper, and these since his death have been made available to the Society. The lively excerpts here printed cover the few months in 1905 when he was organizing his work at the Atlantic end of the Canal under John F. Wallace as chief engineer. Additional installments will follow in succeeding issues.

THE first Isthmian Canal Commission had been appointed and had in turn appointed John F. Wallace (a Past-President of the Society, and formerly chief engineer of the Illinois Central Railroad) as chief engineer. He had taken charge of operations.

I had some correspondence with Mr. Wallace concerning a position on the Canal, and I also applied to my friend B. M. Harrod (also a Past-President of the Society), a member of the Canal Commission, who had been a member of the Mississippi River Commission. But my appointment when it came was from the Commission itself, reading as follows: "To take charge of dredging on the Isthmus whether by contract or otherwise with the rank of Division Engineer." The appointment was to become effective about January 1, 1905.

It was clearly considered not quite the proper thing to employ engineering assistants for the construction of the Canal except through the Chief Engineer, and evidently my appointment raised a strong protest for within a very short time I was told, "You will take the next boat to Panama and see Mr. Wallace. If he wants you, he can keep you; if not, you can come back."

This was a memorable trip in many ways. I had never been to sea before and was sick from the time we started on the *Finance* until she docked at Colon, seven days later. Incidentally I made 14 trips in all between New York and Colon and each one was worse than the last. As one steamship captain used to say to comfort me, "Anyone who would go to sea for pleasure would go to hell for pastime."

To those who inquired, I did not want to admit that I was not sure that I had a job at all, so I said that I was a Division Engineer. "Oh no," the said, "that cannot be, for there already a Division Engineer Culebra and Cristobal."

Before landing, a young man fro the general office came aboard a interviewed everyone. He told ea one where to go, how to get the and to whom to report. When h came to me, he said, "Oh! M Wallace will see you in Panama In the forenoon of the second day was sent for and told that M Wallace would see me. "Ha!" I sa to myself, "this is where I get a r turn ticket to the States."

Mr. Wallace was very cordial an friendly, and after the usual obse vations concerning the tropical we ther and matters of health, plunged into the subject what was being done and what should be done in th immediate future. Nothing was said as to how I came t be there, my appointment, rank or salary, and I do no recall that anything was said about dredging, except in very general way. He then said, "I want you to tak charge of the Atlantic and Pacific divisions. You wi make your headquarters at Cristobal, as that [the Atlan tic] is much the more important end of the Canal at presen You can live in house No. 1. There is a Resident Engine in charge there now, who will give you information as t what is being done. I want you to build up an organiza tion so complete and efficient that you won't have to d anything but sit on the veranda and smoke good cigars."

I took the afternoon train to Colon and proceeded t the old Washington Hotel. The next morning I went t the office of the Resident Engineer, a pompous German I remember particularly one piece of equipment he ha in use—a large cutter or yawl manned by 6 men, eac pulling a single oar or sweep. There was a fancy coverin over the whole length of the boat with cushioned seats i the stern, all quite luxurious, and kept manned at a times for the use of the Resident Engineer. There wa no place for him to go, officially, except half a mile u the old Canal to a shop or to the docks at Colon, both which were accessible by cab. This outfit was prompt dispensed with.

On the point, between the entrance to the old Can and Limon Bay, stood an enormous two-story house wit a wide veranda at each floor on all sides. It faced th Atlantic Ocean, looking towards Pittsburgh, which often thought was a long way off. It was surrounded b beautiful palm trees and by water on three sides. don't know how many rooms it contained, but there wer a lot. On the first floor a single room ran across th front; it must have been 50 ft long or more, by 30 or ft wide. This house was the famous "De Lesseps Pa ace," and was assigned to me as my home! I prompt decided to make it the office. The big reception or dra ing room made a fine drafting room as the ceiling wa very high and there were windows on three sides.

SHORE AT COLON IN 1905—OLD HOTEL WASHINGTON AT RIGHT

The problem of most immediate importance was not to start digging the Canal, but to provide for the care of our men, and to set up facilities for the receipt and handling of enormous quantities of material and equipment.

On the Canal there was no great engineering involved except for its size. It was big. There was a greater amount of excavation to be done with a larger number of steam shovels—but we had operated the same shovels before. There was an enormous amount of material to be hauled long distances; but we used standard flat cars and locomotives, and usual methods. It was a matter of organizing to do ordinary work on a large scale.

I had previously designed and operated dredges of the size and type used there, and while improvements were made in the new equipment, as was to be expected, there was nothing radically new or untried. Especially should it be noted that the engineers could not have built the Canal at all if it had not been for General (then Colonel) W. C. Gorgas, that grand, quiet, lovable man who made the construction possible through his sanitary efforts, including elimination of the mosquito.

I don't want to belittle the engineers. They were the best and most competent in the country (I was one of them myself and very proud of my part in the game). The construction of the Panama Canal was a wonderful enterprise, but the "wonderful" part to me lies in the fact that it was built in a wild and unproductive country, 2,000 miles away from home, where we had to perform every function of civilization. And I mean just that.

We had to house and feed our men, guard their health, and provide for their comfort and recreation. We had to provide schools, churches, entertainment, police, hospitals, water supply and sewer systems, transportation and communication, governmental functions. (If I have forgotten anything, we did it anyway.) And incidentally, we dug the Canal and built the locks.

It was all done within the estimated time, within the estimated cost (as regards actual Canal construction), and without a breath of scandal. That's the wonder of the Panama Canal. It is true that the total cost charged to the enterprise was greater than the estimated cost but the additional cost was due to governmental functions, extra sanitary precautions, and work to make the Isthmus a more delightful place to live. All these were worth while, and worth their cost—but they had not been anticipated in the estimates.

CELEBRATING THE FOURTH OF JULY WITH ATHLETIC SPORTS ON ROOSEVELT AVENUE, CRISTOBAL, DURING THE BUILDING OF THE CANAL

SAMPLING HOSPITAL FACILITIES

The second day after I arrived in Cristobal, I spent most of the day inspecting the work in progress and contemplated in the immediate future. I was of course out in the hot tropical sun. Then in the evening I went back to the hotel and ate a hearty dinner. My stomach would not stand for such treatment, and during the night I had a violent attack of diarrhea.

I sent for a doctor. He wanted me to go to the hospital. In order not to appear childish, I agreed and he took me down. The Health Department was taking no chances, for although I had been on the Isthmus only 5 days, this was long enough for me to develop yellow fever if I had been exposed to the proper mosquito.

The hospital was an old ramshackle, two-story frame building, standing on a pile foundation at the water's edge. People came and looked at me through the screen as if I were a wild animal of some sort. It was a cheerful situation for a stranger in a strange land, and I felt sure I had no yellow fever. (There were a few cases on the Isthmus and very shortly there were more. In the aggregate, we lost quite a number of men, some of them in my own organization, but the proportion was very small and the disease was soon stamped out entirely.)

After the first day, my stenographer brought mail and I dictated correspondence, as I had recovered. A minor foreman in the Panama Railroad shop was brought to the ward suffering from some small injury, and he demanded in a voice that could be heard all over the ward, that he be given a "private room." He was advised that there was none—that the Division Engineer was in the ward and had not demanded a private room. He was silenced, but it was amusing for a few minutes.

After I had been in the hospital about a week, I got up, dressed, and announced that I was going to the office. The doctor of course protested, but finally said, "Well, you will come back nights." "All right." I have never been back and consequently have never been discharged. That was the extent of my hospital experience for over 30 years.

I took over the Resident Engineer's cook along with his house. She was a coal-black Jamaican weighing over 200 lb and a good plain cook. In the very early days our only source of supply for meat, vegetables, and eggs was a native market, and "Lucretia" was the buyer. Every evening after dinner she came and squatted down on the floor beside my chair holding what money she had left on her open hand. She would tell me in great detail everything she had bought during the day and what each item had cost. It was up to me to add the items, count the money in her hand, and see if it balanced with what she had had the night before. I then gave her what she thought she would need for the next day. A very simple system of bookkeeping, and we had no bills.

As my old employees arrived, I took them in as far as I could, and the "Maltby Mess" had quite a reputation for its jolly lot of people, and as a place where a visitor was always welcome. These people I had taken into my house never did give up their rooms there, and I never had but one bedroom for my own use, even if I was Division Engineer.

One of my young engineers knew a girl that he wanted to marry, but I could not spare him long enough for him to go and get her. One day as a Panama Railroad steamship came alongside the dock the captain shouted to me from the bridge, "I have a package for you, Mr. Maltby." When the ship had been docked and the gangplank run

out, the Captain delivered a beautiful young lady all wrapped up in wedding clothes. But I had to give my "package" to Reynolds Smith the same day I got it!

Americans are an impatient lot, and having decided to build the Canal, they expected it to be done overnight. Hundreds of men were sent down there before there was any way to care for them properly, or any tools or material to work with. This was especially true in the Atlantic Division. No construction work had been done on the Canal for 14 or 15 years. No equipment fit for operation was available; everything was gone to decay. The rapid deterioration typical of the tropics was everywhere evident.

An incident I remember concerns a short piece of track which I wanted to lay to connect with the Panama Railroad, so as to enable us to receive materials and supplies. Through some unknown circumstance, we had some ties. We could pick up plenty of rails from abandoned tracks, and also could pick spikes out of the rotten ties. As there was no spike maul available, we drove the spikes with axes. That was my first track-laying experience on the Isthmus. This condition was rapidly improved, as material and supplies had been ordered and were being received. It does not seem to me, however, that we ever had enough.

SIMPLE EXPEDIENTS HELP SOCIABILITY

The first and most important consideration was the care of our men—their comfort and the protection of their health. We were very short of living quarters, and four or five men were sleeping in a single room in Cristobal. Every effort was made to erect houses as rapidly as possible. Eating facilities were overcrowded and poor. This condition, however, was very rapidly overcome, much more rapidly than the housing difficulty. Most of our men from the States were young, energetic, and ambitious. Otherwise they would not have been there.

Let me tell you that "homesickness" is a very real disease. I know! We worked the men eight hours a day and they could possibly sleep eight hours more. But what were we to do with them the other eight hours? We didn't dare to let them hang around saloons or dance halls, or we would have had to send them home in boxes. It was a serious question.

On one of my trips to the States, I bought a piano, pool table, and card tables, and subscribed for all the papers I could think of. On my return, I took one of the houses, installed this stuff, and started the Cristobal Club—the first, I think, in the Canal Zone. The men could come and go as they pleased, do what they pleased —except that gambling and drinking hard liquor were prohibited—and they were not to raise enough of a rumpus to become nuisances. The dues were nominal, if any. I was president of this club as long as it existed. A 42-piece band was started in which I was one of the snare drummers—a great joke to the Chief Engineer.

We found some interesting remnants of French construction when we started to build a new pier. The French pier was entirely decayed down to the water line. When we started pulling some of the old piles to get them out of the way of the new structure, we found they were of squared timber encased in copper below the water for protection against the teredo, and that the timber below the water was perfectly sound. This was a very successful but expensive method of protection.

I think that when we started on the Canal, I was the only person in a responsible position who had previously been in the Government service and so was familiar with the customs, practices, and requirements of that service. At the outset there was no property responsibility or accountability. If a man broke a shovel, he threw it over the bank and got another. If things were lost, it was just too bad—"buy some more." The speed with which machetes could be lost was phenomenal. I think we bought enough to give one to every man, woman, and child on the Isthmus.

I cautioned my associates that some day they would have to account for all this stuff. Sure enough! Very shortly we received orders to install a system of accountability, based on inventories of old property found and non-expendable property, as shown on invoices of material purchased. And this accountability extended down to those who were in actual charge of the equipment, either in use or in storage.

SOLVING PROBLEMS OF SUPPLIES

Anyone who has been in the Government service and accountable for property knows that a property list sometimes becomes a fearful and wonderful thing. I was appointed a survey officer to inspect and condemn unserviceable property, give orders for its disposition, and pass on questions of shortage and methods of relief.

Some amusing incidents arose. A medical officer was to be relieved and sent to some other station. He could not leave the Isthmus until his property accountability was cleared, either by receipts of transfer, or other appropriate action. His successor had "got wise" by this time and would sign for only such articles as could be found. The doctor took a very arrogant attitude and treated the question of shortage as a matter of no importance. "I don't know anything about those things," he said, "I never saw them."

Days passed, and finally Colonel Gorgas said, "Why don't you let Dr. So-and-So go?" "I am not holding him," I said. "He knows what he can do, but he will have to realize that even a doctor in the Public Service is accountable for Government property issued to him for his use." They afterwards found most of the missing articles, and he was relieved of the rest by suitable affidavits.

My experience had taught me that in the Government service it took a long time to procure any kind of supplies or equipment. This was because of the method in force which required time for preparing advertisements calling for bids, waiting for their preparation and submission, studying them, awarding the contract, and then securing delivery. Therefore it was necessary to anticipate one's wants as far in advance as possible.

I began at once to prepare a long requisition for articles I might need in the first year. Among other items, there was one for 180 coils of rope of various diameters from one-half to three inches. This item and its size seemed a great joke both to the Panama Office and to the purchasing agent in Washington. "What are you going to do with all that rope—hang everyone and everything?" they said, and more. But they bought the rope. Shortly after it was delivered, someone came to me and inquired, "Can you lend me a coil of $^{3}/_{4}$-in. line? I have had it on requisition for three weeks and am entirely out." Another said, "Say, can you let me have a coil of 1-in. rope? I had no idea we could need so much." And so on, until I was apparently the only one on the Isthmus who had any rope. However, I was glad to help out, and my requisition was no longer a joke.

I was not the only one who furnished amusement by his requisitions. Mr. Wallace ordered ten complete standard outfits of tools, material, and equipment as issued to, and used by, section gangs on the Illinois Central Railroad. They arrived and each outfit contained eight or ten snow shovels!

Multiple-Purpose Reservoir Operation of Tennessee River System

Part II. Day-to-Day Control of Flow

By CLARENCE E. BLEE, M. AM. SOC. C.E.
CHIEF ENGINEER, TENNESSEE VALLEY AUTHORITY, KNOXVILLE, TENN.

EFFECTIVE short-range control of river flow requires the accumulation of considerable data. On the highly developed TVA System, extensive records are kept of rainfall and stream gaging, weather, ground-water conditions, and a dozen or more other pertinent factors. Operating problems develop rapidly during a flood and complete data must be available at all times. Thus a routine must be worked out that will supply the needed data. This article by Mr. Blee is the second part of his discussion on the operation of the TVA system of reservoirs. The first part, which appeared in the May issue, covered long-range or seasonal flow-control problems. The material for these articles was presented in an address before a joint session of the Hydraulics and Waterways Divisions at the Society's Annual Meeting in New York.

WATER control on the Tennessee Valley Authority system is centralized in the ice of the Chief Engineer at Knox-le, directly under the supervision an engineer in the Water Control nning Department. This adminis-tive device has the advantages establishing a unified control of ter operations for all purposes, d of placing that control in a de-rtment which is familiar with the nned methods of operation for e system.

Under the established policy of e Tennessee Valley Authority, e operation of the reservoirs is nducted for the benefit of the fol-ing objectives: navigation, flood ntrol, power, and malaria control, well as other miscellaneous and nor purposes. While the superior hts of navigation and flood con-l are recognized at all times, every attempt is made to ordinate the requirements of the various programs so at the needs of each may be met in so far as possible thout injury to the others. Unified control is a prime cessity in operating a system such as that of the Ten-ssee Valley Authority, with its multiple functions.

FORECASTING STREAM FLOW

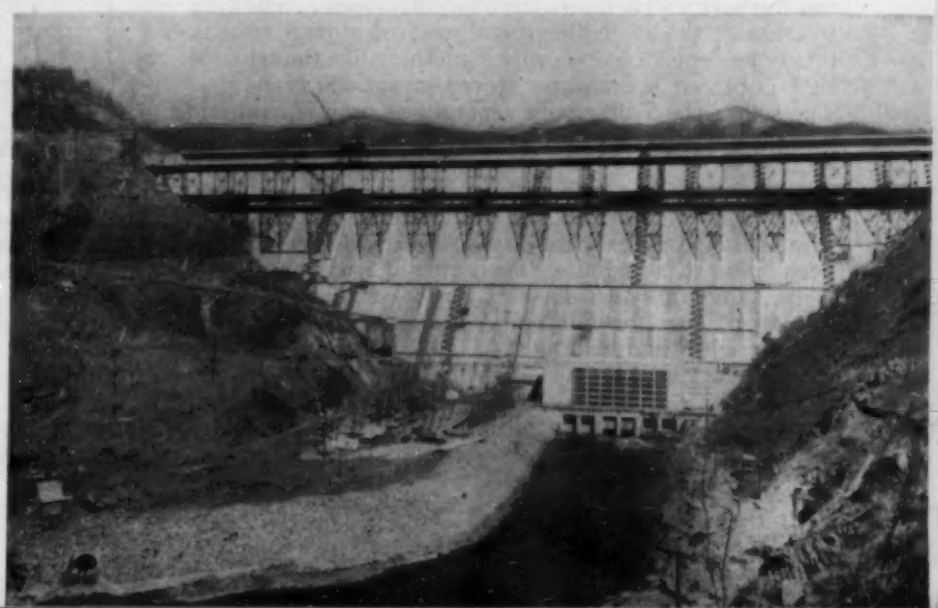
To supply information on rainfall and stream flow roughout the watershed, an extensive network of pre-itation and stream-gaging stations is maintained. bout 150 key stations on this network normally report ch morning by telephone or telegraph to the central recasting office in Knoxville. During flood periods, 90 ditional stations send in reports, and all stations make orts at more frequent intervals if certain predeter-ined criteria as to amount of rainfall and rate of rise f streams are exceeded. From each of the ms information is transmitted to the ice of the Chief Dispatcher of the De-rtment of Power Operations, giving servoir elevations and the rate of water scharge. This information, for the en-e system, is forwarded to the Knox-le office by teletype.

To report the amounts of rainfall and e stages of streams in locations remote m telephone or telegraph lines, the thority has developed rain and stream ges which automatically report their formation each two hours by radio sig-ls. There are now 22 rain gages and 15 ream gages of the radio type installed on e system. These radio gages have oved very reliable in operation and have been invaluable in furnishing information from the mountainous regions of the watershed—information which is most essential for predicting runoff.

In connection with stream-flow forecasting, the TVA is using quantitative weather forecasts furnished by the U.S. Weather Bureau under a cooperative agreement whereby the Bureau makes special forecasts twice daily covering the Tennessee Valley and its major subdivisions. About 8 a.m. an early-morning preliminary forecast is received which is based on conditions as of the preceding midnight. This is followed up about 11 a.m. by a final forecast giving predicted weather conditions for three to five days in advance, and amounts of rainfall expected in the various subdivisions of the Valley for two days in advance.

Daily information normally starts to come into the Knoxville office about 6 a.m. As rainfall records are received, they are written on an outline map showing the rainfall and river gaging stations (Fig. 1). This information, in conjunction with preliminary weather forecasts, stream-flow data, and reservoir information, is grouped according to tributary drainage basins and is then analyzed by engineers assigned to specific parts of the system. Runoff is estimated for the current day and for the three days in advance. It has been found preferable to base the primary forecasts of runoff on the rain which has actually fallen to date.

These estimated runoffs are reviewed in connection with the amount of rainfall forecast, the storage existing in each reservoir, and the needs for power production. Then decisions are reached about noon as to how the reservoirs shall be operated. A daily bulletin is then



ORRIS DAM ON THE CLINCH RIVER IS TYPICAL OF DAMS ON TRIBUTARIES OF THE TENNESSEE

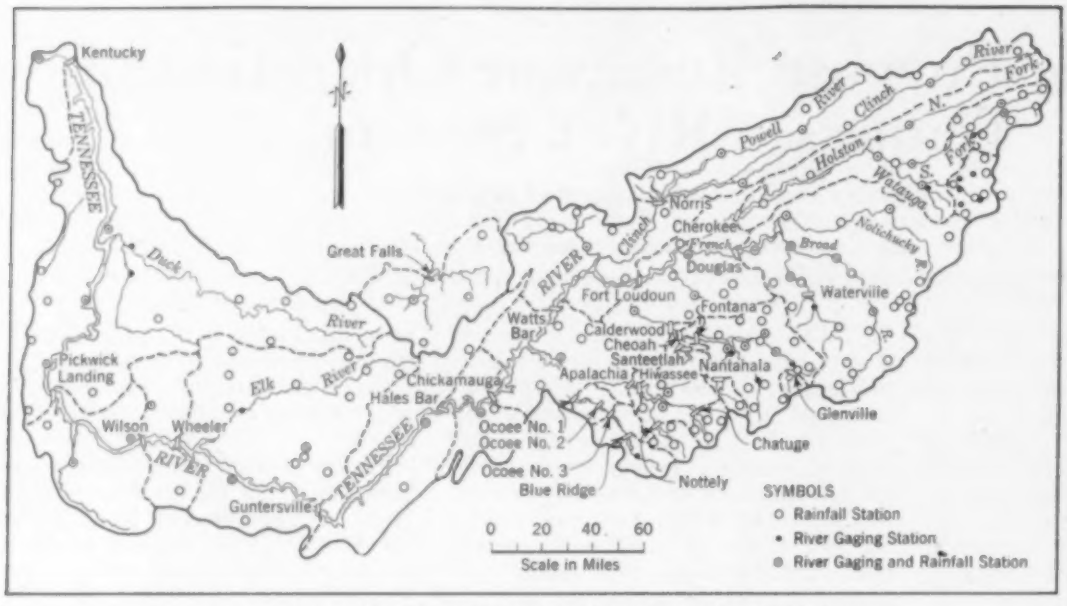


FIG. 1. RAINFALL AND RIVER RECORDING STATIONS IN THE TVA SYSTEM

issued giving: the current inflow, discharge, elevation, and the change in elevation from the previous day for each reservoir; the discharge, stage, and change of stage at key points on the main river and tributaries throughout the Valley; the forecast inflow, discharge, and elevation at each reservoir for three days in advance.

In selecting the proper factor to convert rainfall into runoff, good judgment gained by experience and based on extensive data is required. Taking the watershed as a whole, the mean annual rainfall is 52 in. and the corresponding runoff is 23 in., giving a ratio of runoff to rainfall of 44%. This ratio varies considerably in the various sections of the Valley, and there is a striking seasonal variation in the relation of runoff to precipitation even for the average monthly figures, as is shown in Fig. 2. The runoff from individual storms or locations is affected by many factors such as conditions of the soil surface, depth to ground water, rate of precipitation, soil cover, and state of growth of vegetation. The surface runoff from a prolonged storm in the wet season may be as high as 75% of the rainfall, while the corresponding runoff from a short storm with equal intensity of rainfall, but at the end of a dry period, may not be more than 25% of the rainfall. This is one reason why summer storms do not result in more severe floods.

Several references have been made to the influence of ground water on the available supply of water. This has in the past been recognized in a qualitative way but the Authority's engineers have recently been attempting to estimate the available ground water in storage so that it may be depended upon with something like the reliance that is placed upon water stored in surface reservoirs. The soil of the Valley is in general fine grained and not particularly favorable for the storage and giving up of ground water.

Moreover, there is a wide variation in the groundwater characteristics of different basins in the Valley. The 2,912 sq miles tributary to Norris Reservoir has been found to contribute a maximum of 2.7 in. of ground water, amounting to 420,000 acre-ft, while the corresponding figure for Fontana Reservoir with its deeper soil cover is 8 in., yielding 670,000 acre-ft from 1,571 sq miles. The methods developed for estimating the amount of ground water in storage are interesting, but space does not permit a detailed description of them. Basically they depend upon the hypothesis that the rate of flow

from ground-wat
sources is an index
the amount of grou
water in storage.

In routing floo
through a syste
formed by a series
reservoirs it is nec
sary to take accou
of a number of facto
One of these is t
rate of travel of tra
latory waves throu
both open chann
and reservoirs. T
results and conclusi
from a series of expe
ments carried out
the Tennessee Riv
system to determi
such rates of trav
and to compare the
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values computed fr

formulas, are well presented in the paper, "Translato
Waves in Natural Channels," by J. H. Wilkinson, M. A
Soc. C.E., in the June 1944 PROCEEDINGS of the Societ
While the actual rates of travel are affected by a numb
of variables, the velocity in open channels is in the ord
of 3 to 5 miles per hour, while that in a reservoir is
the order of 15 miles per hour.

Another factor which must be recognized in manipula
ing a series of reservoirs is the variation, with rate of di
charge, of the amount of water under profile storag
As the rate of flow increases, the gradient of the bac
water curve steepens, thus increasing the amount
water in the reservoir as compared with the flat po
storage on which capacities are generally based.

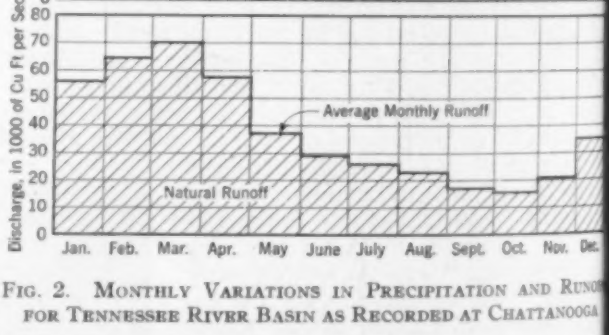
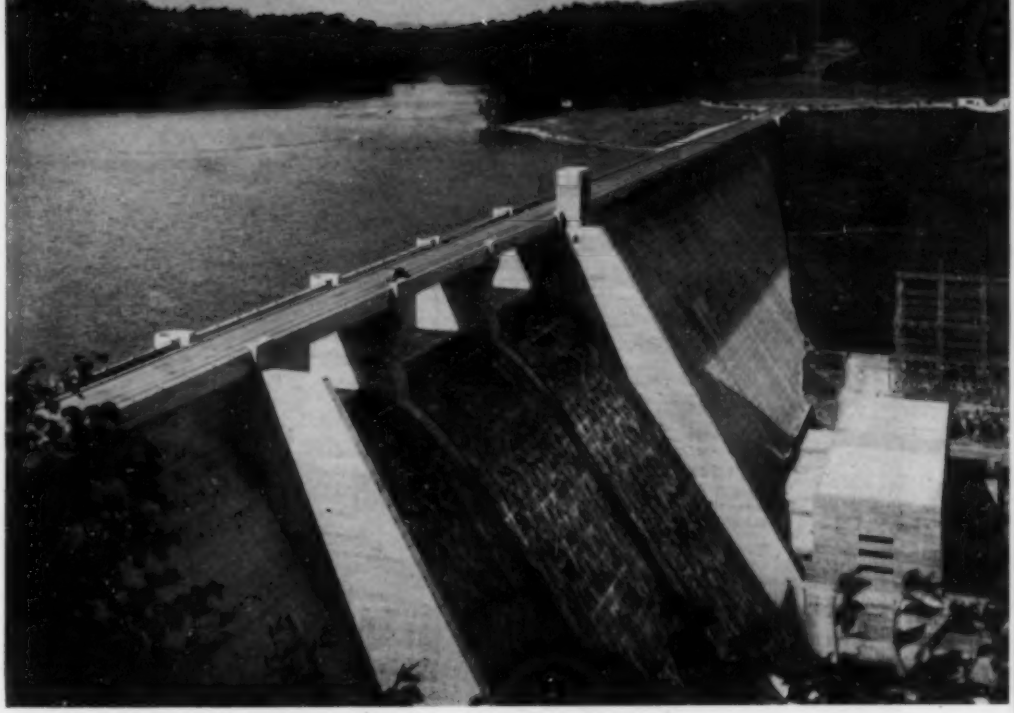

Precipitation in Inches
Average Monthly Precipitation
Precipitation on Drainage Area
Discharge, in 1000 of Cu Ft per Sec
Average Monthly Runoff
Natural Runoff
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

FIG. 2. MONTHLY VARIATIONS IN PRECIPITATION AND RUNO
FOR TENNESSEE RIVER BASIN AS RECORDED AT CHATTANOOGA

Wheeler Reservoir during the 1942 flood, when the di
charge into and out of the reservoir was 220,000 cu f
per sec, the volume under profile storage was 1,410,00
acre-ft, whereas the level pool storage is 1,131,000 acr
ft, an increase of 279,000 acre-ft.

This variation in storage with conditions of flow ma
be an asset or it may be a liability. When discharg
rates are being increased, as is generally the case in th
earlier stages of a flood, the reservoir is able to absor
more stored water than it would under flat pool condi
tions, at the same time holding a constant level at th



FONTANA DAM AND POWER HOUSE—NO. 1 UNIT WAS PUT ON THE LINE IN JANUARY, AND NO. 2 UNIT IN MARCH 1945

scharge dam. While this is advantageous, it must be remembered at as the inflow is reduced, the ofile tends to flatten, and the deasing amount of storage results a surplus of water which must be ken care of.

In operating for the reduction flood peaks on the lower Ohio d on the Mississippi below Cairo, e obvious strategy is to discharge much water as possible from the nnessee system ahead of the ak on the Mississippi at Cairo, d then hold back the water iginating in the Tennessee basin til the peak at Cairo has passed. s was mentioned in the previous stallment, Kentucky Reservoir, ith its large flood-control storage cated near the mouth of the nnessee River, is in a particurly favorable position with reect to such operations. Also, ith the main Tennessee River conerted into a continuous series of dams and reservoirs, en the storage reservoirs on the upstream tributaries n be made quickly effective on the Ohio by manipution of the intervening reservoirs.

In operating the reservoirs above Chattanooga to ast in reducing flood peaks on the lower Ohio and Mississippi, and in reducing major floods at Chattanooga, e flexibility of the operations is limited by the rate of ow which can be discharged past Chattanooga without maging the city. Construction of levees and other otective works at Chattanooga, which has been recomended to supplement the control afforded by the reserir system and so protect the city from floods greater an the flood of record, would remove this limitation.

In handling floods, centralized control and prompt desions are essential. One of the most important factors successfully controlling a major flood by a large system reservoirs such as the Tennessee River system, and uting the flood waters past critical points, is timing. iming is of the utmost importance and the accomplishent of this necessitates accurate data as to hydraulic ctors, adequate means of controlling the release of ater, and the prompt issuance and execution of instrucons governing the control operations by those intiately familiar with the details of behavior of the system nder control.

RELATION TO CONTROL OF THE MISSISSIPPI

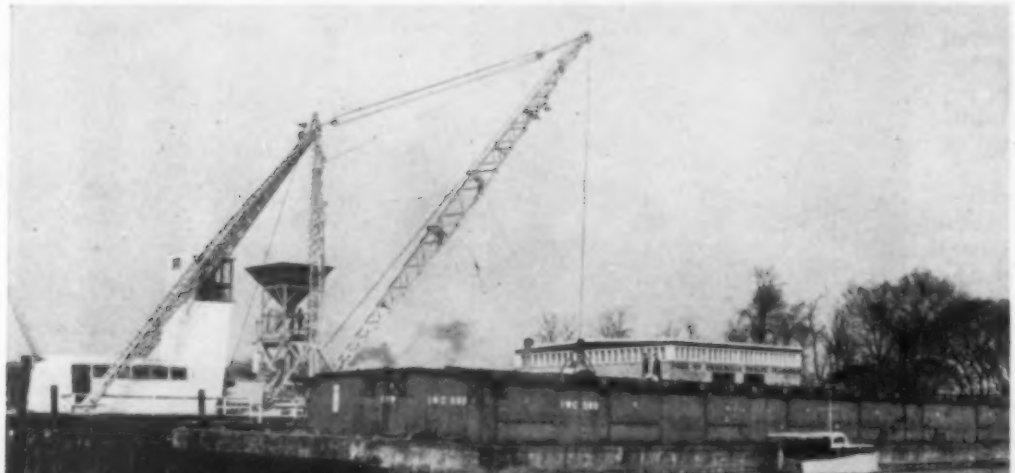
When a large river system such as the Tennessee is ibutary to another river—in this case, the Mississippi rough the Ohio—it is highly desirable that the disarge from the tributary river, at the time of a major od on the main stem, be coordinated with the control anned for the main river. Those exercising the control the main stem are concerned with the amount and e time of occurrence of discharges at the mouth of the ibutary into the main river. The obtaining of these sired discharges from a large tributary such as the nnessee can best be assured by a control of operations hich is centralized in the agency responsible for the anning and development of that river system.

With the multiple objectives prescribed by the Tennesee Valley Authority Act, the many projects making p the reservoir system, and the intricate operating oblems, the control necessarily becomes a function for localized authority. In meeting the statutory obligation of the Authority to contribute to the control of floods on the Mississippi River, it has been the practice of the Authority's engineers, at times of expected floods, to exchange information with the Office of the Division Engineer of the Corps of Engineers. Actual and predicted discharges are compared, and the discharges to be released at the mouth of the Tennessee are coordinated with that office. This cooperation makes it possible to reduce flood peaks most effectively on the lower Ohio and Mississippi rivers. Recently this arrangement has been formalized by an amendment to the current Flood Control Act which directs that, in case of danger from floods on the Lower Ohio and Mississippi rivers, the Tennessee Valley Authority is to regulate the release of water from the Tennessee River into the Ohio River in accordance with such instructions as may be issued by the War Department.

MECHANICS OF WATER CONTROL

In carrying out the mechanics of water control for the Tennessee Valley system, written instructions or memoranda are issued periodically by the Water Control Engineer, setting up operating requirements and limitations in advance. In the case of a flood or other emergency, instructions are given by telephone and confirmed by memorandum. All instructions are issued to the Superintendent of Power Operations and transmitted by him through the Load Dispatcher to the power stations at the dams concerned, where the actual gate operations are performed by the power-house crews. The reliable and positive transmission of instructions, particularly in times of flood, is an important matter. And it must be borne in mind that during an exceptional flood ordinary means of communication, such as commercial telephone and telegraph lines, are liable to be interrupted at the time when they are most needed.

On the TVA system there is a power-generating station located at, or a short distance from, practically every dam, and the communication facilities developed for load dispatching are used for transmitting instructions for water control. Each power house is connected with the main lines of the commercial telephone system by substantially built extensions. In addition, communication is provided by a carrier-current telephone system



UNLOADING CARGO OF WHEAT FROM ST. LOUIS AT KNOXVILLE TERMINAL
Navigation Is an Objective of TVA Reservoir System

which operates by radio transmission, following channels afforded by high-voltage transmission circuits.

With respect to the design of the structures forming a part of the Tennessee River system, there are but few features which are peculiar to the method of operation. All the tributary storage dams are provided with sluiceways or low-level outlets as a means of discharging water when the reservoir level is below the spillway crest, and when wasting of water is required to maintain or restore space for flood control storage. Precautions are taken to insure the reliable operation of spillway gates, but such measures would be taken with any dam of equal importance.

TYPES OF MULTIPLE-PURPOSE PROJECTS INVOLVING FLOOD CONTROL

The most important factor in the successful operation of a multiple-purpose water-control system is that the system shall have been planned and designed for the method of operation to be carried out. There are three different methods of approach or conceptions as to the design of multiple-purpose projects involving flood control: (1) the idea that a reservoir must at all times be kept empty for flood control; (2) the view that there must be a designated portion or definite layer of the reservoir reserved for flood control and another portion for other of the multiple uses, with no common use of the same space; (3) the view that the same space in a reservoir may be used both for flood control and for other purposes at different seasons of the year.

Each of these conceptions has its proper place and each has been successfully and economically employed. The first is essentially the detention-basin type of development and can have little if any other use than for flood control. The reservoirs of the Miami Conservancy District in Ohio are an example of this type of project. In studying the flood control problem of the Upper French Broad River in the Tennessee Valley, the Authority's engineers have tentatively proposed the use of detention-type reservoirs for such a project. Here the streamflow distribution is not favorable for power development; economical sites for reservoirs of large capacity are not available; and the record indicates that major floods may be expected in any season of the year.

The second method—that of reserving a definite portion or layer of the reservoir for flood control—has been used in the design of a number of multiple-purpose projects. The Norfolk Dam, recently constructed in Arkansas by the Corps of Engineers, is an example of this method of approach to multiple-purpose operation. The planning of the Watauga and South Holston projects in the northeastern end of the Tennessee Valley is based on reserving exclusively for flood control the space above a certain fixed elevation in each reservoir. In the case of these projects, the topography and the lack of development in the area are such that reservoirs of comparatively large storage capacity may be obtained at reasonable cost, but damaging floods may occur in any season of the year.

The third method—that of utilizing the same space in a reservoir for flood control during one season and for other purposes during another—is the method generally used as the basis of planning and design for the system of water control in the Tennessee Valley as now constructed. The following conditions favorable to such a method of multiple-purpose operation are present to a high degree in the Tennessee Valley:

1. Major floods are consistently confined to a definite flood season.
2. Topographic conditions and the extent of improvement in the reservoir areas are such as to favor relatively large storage capacities at moderate cost.
3. The annual runoff cycle is such as to favor the required degree of filling of the reservoirs after the end of the flood season.

The important thing, and the point which I wish to stress here, is that in considering a multiple-purpose project, all available basic data must be assembled and the proposed method of operation determined by an engineering analysis directed toward serving the desired purposes in the most economical manner. This problem is like other engineering problems where we have certain controlling conditions which can be determined and appraised, and also certain objectives which must likewise be appraised and balanced one against another, so that the solution arrived at will fit all the factors involved.

In planning the reservoirs forming the Tennessee River System, the engineers of the Tennessee Valley Authority have studied the controlling conditions and have adopted the methods of multiple-purpose operation that most economically produce reliable flood control, adequate navigation facilities, and substantial power production. The operation of the system has been carried out over the past several years as planned. During that time a number of moderately large floods have occurred and have been successfully controlled. No extremely large floods have been experienced, but the planned reservations of reservoir space for flood control have been maintained, and such a flood may be awaited with confidence that it will be controlled as planned.

Importance of Construction in Our Postwar Economy

Today's Construction Labor Force Equals Total Population of United States in 1790—Address Presented at a Meeting of the Philadelphia Section

By MARK B. OWEN, M. AM. SOC. C.E.

RECENTLY DIRECTOR OF COMMITTEE ON POSTWAR CONSTRUCTION, AMERICAN SOCIETY OF CIVIL ENGINEERS

INTELLIGENT appraisal of the present status of postwar construction planning and the significance of a postwar goal can be made if one examines the building statistics of the immediate prewar years. The greatest volume of total construction, which includes maintenance, was achieved in 1929, when almost 14 billion dollars was invested in the activity. In that year the private expenditure for new construction and maintenance was approximately 10.8 billions, or 78% of the entire program. Public works contributed only 22%.

While our greatest home-building year was 1925, during which nearly a million homes were provided at a cost of 4.6 billion, or about 56% of the amount spent on all private projects, the 1929 program of home building provided over 3.5 billion, or 45% of all private construction, and has never been approached since that time. New construction hit an all-time prewar peak in 1927 with a value of about 11 billion dollars.

PRIVATE CONSTRUCTION PLAYS VITAL ROLE

The importance of private construction cannot be overemphasized. During the decade ending with the close of 1929, private investment in the building industry furnished over 81% of the total of all construction in 1923, and averaged more than 78% for the ten-year period. In all the 20 prewar years, it was only in 1932, 1933, and 1934 that publicly financed projects contributed as much as half of all new construction.

State and local sponsors of public projects made their greatest contribution in 1932 in furnishing 37.8% of the dollar volume of all new construction activities. The federal participation, including federal aid and PWA grants, was a maximum in 1935 with a 24% share of the dollar value of work, while private building accounted for about 57% during the same period.

Millions of men out of work in the depression years of the thirties, and dependent on the public works construction program for a living, focussed the attention of more and more people on the importance of building activities. Indeed, the publicity attendant upon the Public Works Administration programs has led many people to look on these activities as social measures for the relief of unemployment. Useful and needed public works are as essential to our economy as the structures provided by private interests, but they should not be conceived for the sole purpose of providing jobs.

CONSTRUCTION LABOR FORCE

Today the construction labor force is almost as large as the entire population of the United States was in 1790. Out of every 17 workers in the total U.S. labor force of 1940, one was directly engaged in new construction and maintenance activities. Of all those so employed, 75% were skilled workers; common labor therefore represented only 25% of the total.

We are inclined to think of the construction labor force as it may be related to the activities of general contractors. While establishments such as building contractors, speculative builders, highway and heavy contractors, special trades contractors and others, perform work valued at about half of the total annual construction program, the number of people they employ is slightly more than one-third of the construction labor force. The remainder represents the self-employed and those engaged in force account work for public utilities, governmental agencies, building management concerns, home owners, industries, and others.

GOAL OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS FOR PLANNING AND CONSTRUCTION

Spot-lighting the important construction segment of the national economy is the program of the American Society of Civil Engineers, implemented through its 64 Local Sections by the Committee on Postwar Construction.

Specifically the Society believes there should be 15 billion dollars' worth of new construction planned and ready for bids for the first year of peace. Further, this volume should be supported by a three-year program of projects forming a continuing shelf of reserve plans ready for action when the occasion demands.

Based on past records and recent studies, it is thought that two-thirds of the 15 billion should be provided by private construction and one-third by public works. One-half of the 10 billion-dollar program is estimated to represent residential building and the other half small hand-craft construction. One-third of our total program is therefore private residential work.

The Society's Action and Advisory Committee to the National Committee for Economic Development concurs with the Committee for Economic Development in thinking our postwar national income ought to be maintained at about 140 billion in 1940 dollars. By applying the prewar relation of new construction to national income to a 140-billion-dollar postwar income, the Society's construction goal of 15 billions is established.

Maintenance work in the past has averaged about one-third as much as new construction, in dollar volume. Owing to wartime restrictions, there is a large backlog of maintenance. This class of work may easily exceed five billion in the first full year of peace.

Delayed maintenance, plus the Society's 15-billion-dollar postwar goal, represents an investment in construction of 20 billions. In terms of jobs, both on-site and off-site, and people dependent on these workers for subsistence, there could well be more than 30 million people affected by this volume of activity.

STATUS OF POSTWAR CONSTRUCTION PLANNING

After two years of postwar construction planning, more than 80% of the reported dollar volume of engineering projects in the design stage has originated in 12 states in which reside 53% of the population. The value of projects being considered for the postwar era as of

March 1, 1945, is 19.1 billion but only 7.2 billion worth has advanced from the proposed stage to the design stage. A few have been brought to the status of "ready for bids"—now estimated at only 619 million. That is to say, after two years of planning, only about 3% of the proposed work is now ready for bids.

Only those projects that are carried beyond the design stage to the ready-for-bid status can be translated into jobs. Until all plans and specifications are completed, financing arranged, land rights cleared, and legal obstacles overcome, no project can be said to be ready for bids.

WHY PLAN NOW

The bottleneck—and a serious one, holding back the reemployment by the construction industry of thousands, perhaps millions, of people—can be, and may be lack of building projects ready to advertise for bids when the occasion demands. This places the responsibility squarely on the shoulders of the people and organizations having a definite need for construction.

An adequate shelf of both private and public plans is a "must" if another WPA program is to be avoided. In the thirties, when the PWA had 3.3 billions to spend on useful public works, let to contract after competitive bidding, it was 18 months before 100,000 men were at work. This delay was because of the lack of sufficient plans, and was the direct cause of the WPA made-work program.

While there is an unavoidable lag between advertising for bids and start of construction on public works contracts, the same is not generally true of private projects. On both types of projects it is well to remember this: It takes twice as long to plan a job as it does to build it.

COMMUNITY PLANNING

Postwar construction programs should be community programs, planned and carried out at the "grass roots." They must be local in character. "No one can solve community problems so well as local people themselves. No one else can possibly be so interested in local prosperity, or so much affected by local depression. Moreover, no one else knows so much about local conditions." Each and every community should rely on its own resourcefulness in carrying out its program. All the private and needed and useful public construction proposed in the community should be planned now and a schedule prepared establishing project priorities for construction.

Public works projects are easily controlled as to timing and should not be allowed to compete with private construction for labor. Private construction should lead the building program because it always stimulates and creates the need for public works. The reverse is not true—we saw that demonstrated in the depression of the thirties.

SUGGESTIONS FOR SPECIFIC ACTION

All that I have said has been for the purpose of highlighting the importance of construction in our economy at national and local levels, and the necessity for action now in stimulating the preparation of private and public postwar construction plans. While almost everyone is busy now contributing his or her bit to winning the war, somehow or other time must be found to spend on efforts to assure optimum employment during the reconversion period and high-level employment during the peace years which it is hoped will follow.

Recently the National Committee on Postwar Construction of the American Society of Civil Engineers became the 20th Action and Advisory Committee of C.E. to assist any or all local groups in stimulating the pre ration of private and useful and needed public constr tion plans. In many communities C.E.D. has comple surveys of industry and business to determine their po war production and employment plans.

Expanded production and business should in ma cases require new or additional plant and housing str tures. It seems logical that a construction survey sho immediately follow the industrial and commerci surveys.

Since the objective of C.E.D. is jobs, no local cen of postwar employment can be complete without inc sion of the construction program. Factual informati regarding postwar construction is necessary in order determine the number of jobs this segment of t economy will furnish. Furthermore, the period of ti in which it will be carried out should be known so that community construction can be scheduled. This w avoid competition for labor and the severe peaks a valleys of construction employment.

Each local organization should contain an active Co struction Committee that includes members represent the following groups:

Civil engineers	Real estate developers
Architects	Building and loan associations
General contractors	Bankers
Builders	Veterans' organizations
Building supply dealers	Trade unions
Equipment dealers	Civic officials
Real estate brokers	

Local conditions may suggest the addition of others this list.

The construction committee should conduct a surv to determine the dollar volume of proposed plans for n factory buildings, new commercial buildings, non-far homes, farm homes and service buildings, public wo and new additions to any of those mentioned. Furth the survey should include the dollar value of propos modernization of all structures, as well as maintena and repair work.

INTERPRETATION OF THE RETURNS

As mentioned before, the survey should show in wh year or years the work will be carried out and the stat of plans covering it. The tabulation and interpretati of the returns should show the following:

A. The dollar volume of construction that is definite proposed
B. The year or years in which it will be carried out
C. The status of plans
D. The value of materials to be used in the structu
E. The number of jobs that will be provided
F. The number of local people this activity m support

Every community should prepare a postwar progra now. Every community postwar organization sho include an active construction committee with at le one engineer member. To insure favorable postw economic conditions, the immediate preparation of construction program is essential. This is particular true while our country is engaged in a war to preser American ideals and liberties. Victory is our primary o jective, regardless of its cost. Our wealth, our resourc and our citizens are now wholly committed to t righteous cause. True patriotism, however, transcen wartime fervor—it also demands adequate planning f peace.

eabees Assemble Pon-oons at an Island Base

By SAM BARASH
SK 3/c, U.S. NAVY CONSTRUCTION BATTALION

1943, when pontoons were fast becoming the step-ing-blocks to our Pacific island invasions, a Seabee oon Assembly Detachment landed in New Cale-a with its shipload of prefabricated pontoon sections. Stateside civilian pontoon manufacturers," recalls Lt. dr. William R. Easley, U.S.N.R., Officer-in-Charge his detachment, "were sure it couldn't be done. claimed that the set-up and operation of an acre-assembly-line pontoon plant would be impossible r tropical conditions and without a large reservoir ained personnel."

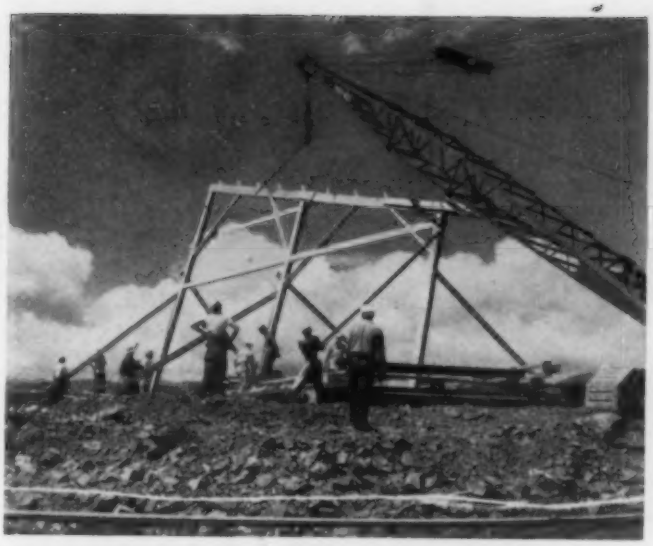
he Navy was willing to gamble though. Amphibious are in the Pacific demanded thousands of pontoons myriad uses—and lack of shipping space seriously ed pontoon supplies for fighting and building units. nocked-down pontoons could be assembled at a

Official U.S. Navy Photo

SEABEES AND ARMY ENGINEERS JOINED FORCES TO ERECT QUONSET HUTS ON ENIWETOK

ific base close to the fighting fronts, an estimated 11 of every 12 pontoon-cargoed ships would be saved for r vital war uses. During its first year of operation, only 290 men to build and man its ory and supply general overhead maintenance crews, this Seabee achment "came through" on the y's gamble, averaging over one sand assembled pontoons per th, refuting the manufacturer's pre-ons, and bettering the previous an output of 960 pontoons per th for an equivalent plant.

eavy tropical jungle was pushed by the detachment's own con-ction equipment to make room for pontoon assembly plant. Inex-enced men "went to school" right on line with men who kept the finished toons moving. Techniques for the ination of vertical welding in the



Official U.S. Navy Photo

A WAREHOUSE FRAME RISES—LUMBER WAS BROUGHT IN FOLLOWING LANDING

assembling of pontoons were devised and, only months after landing, the detachment was shipping pontoons to scattering fighting units near its base.

Now removed from New Caledonia to an advanced Southwest Pacific Naval Base in the Admiralty Islands, the detachment, in its second year of overseas production, has been enlarged to 500 men. It has increased its average to 1,600 assembled pontoons per month, and has taken over the assembling of varied pontoon structures. Also it has outgrown its original experimental nature, since three other units modeled on this first Pontoon Assembly Detachment are operating from other Pacific bases.

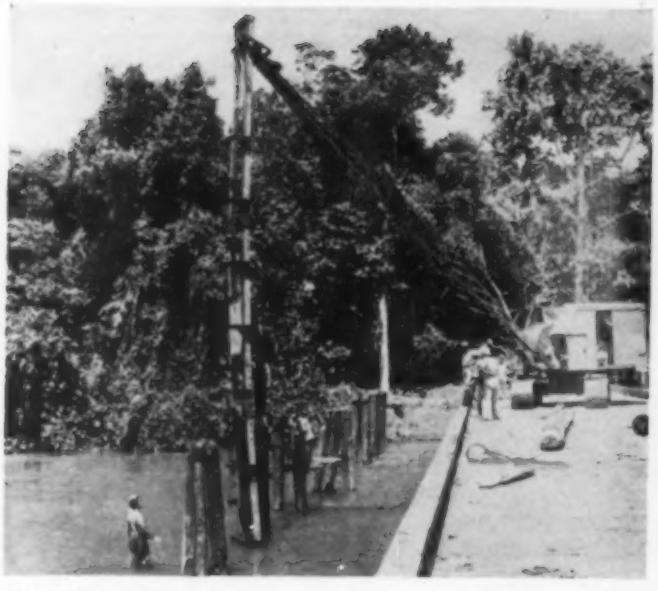
Nestled under jungled hills and fronting on its own pontoon drydocks, the assembly plant is a long 400-ft shed alive with men, moving pontoons, and welders' flashes. It is subdivided into the T-7 pontoon assembly department and the T-6 standard section.

The T-6 finished pontoon, "box-type," with its overall dimensions of 5 by 5 ft for ends, and 5 by 7 ft for sides, deck and bottom, is the standard building block for all pontoon construction; while the T-7, used for bow and stern float sections, approximates the T-6's dimensions except for its curved end.

Assembled entirely from mild-steel prefabricated plates and "jewelry" (T-beams, angles, and stiffeners cut to required length and shipped in from the States), the pontoons move through the length of the plant, and out into

Official U.S. Navy Photo

WORK AROUND THE CLOCK IS THE RULE IN GETTING A BASE ESTABLISHED



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FOR DOCKING FACILITIES, NATIVE LOGS WERE DRIVEN IN PILE CLUSTERS

the test and paint sheds and the final storage dumps, on miniature railroad flat cars.

Arc-welding, the basic operation in assembly, binds and water-seals the pontoon. Over 100 ft of weld bead are required for one pontoon. More than 80,000 lb of welding rod are consumed monthly by the plant's torches.

At the head of the assembly line, mild-steel sheets are laid on original design table jigs—and stiffeners, after being clamped to the sheets with jig clamps, are welded to the plates. An assembly jig holds the plate sections in place for tack-welding, after which cranes move the partially welded pontoons to the welding pits, where perfectly balanced rotating mechanisms permit one welder to rotate, by the push of a hand, a ton-and-a-half pontoon. Through the use of these balanced jigs, designed and built by the detachment, vertical welding is eliminated, trainee welders can become part pf the production line using only the comparatively simple downhand and horizontal welding positions, and training time is reduced, with a corresponding increase in pontoon production.

Internal welding beads stiffeners, gusset plates, and backing strips. Although compressed air is used for ventilation, the close confines, heat from the torch, a heavy protective clothing make "it hotter'n h— inside

The pontoon is then given a preliminary 15-lb wa test, leaks are rewelded, and corner-straps, which used for the later mating of pontoons into structures, attached. The dimensions of the assembled product checked to $^1/_{32}$ in.

A narrow-gage railroad flatcar rolls the pontoon to outside test and paint shop for gage checks and wate proofing, and finally into the end-of-the-line stora yard. There towering stacks of completed pontoo block out rectangular sections of the tropical sky wh they await their call to structure assemblies.

On the dock, individual strings, consisting of from 8 12 pontoons, are "tied together" with long angles, link pins, and bolts, and are launched into the water. Lat these strings are assembled to form complete floatin units. Clamps and tie-rods bolt the bottoms of com pleted structures together for quick assembly and quic dismantling.

More than 100 different types of structures for coun less war uses are assembled on the docks. Located clo to the fighting fronts, the pontoon assemblers me active demands for new war-improvised types of pontoo structures with quick assembly and delivery.

Barges, varying from 2-by-7 to 6-by-18 pontoons, 10 ton to 800-ton drydocks, wharves of any specified si

Official U.S. Navy Photo

FIRST OF ALL ISLAND OPERATIONS—CLEARING SHATTERED PAL

bridges for light and heavy loads, self-propelled tugs, a seaplane slips, are now built by the men of this Seab detachment from its own assembled "cigar boxes." T barges leave the detachment's docks for use as carrier floating ammunition dumps, net tenders, floating stora dumps, crane barges (capable of supporting up to 75-to lifts), and fuel and water tank floats. The barge bridges, tugs, wharves, and drydocks find their work this base and at advanced areas in the north. Even the detachment's own plant area, stray pontoons supp water and fuel, and serve as a foundation for the mov projection booth. "We probably," says Lt. Comd Easley, "have the only pontoon brig in the Pacific

The Seabee assemblers also maintain a depot for tran shipped pontoons delivered assembled from the State and a pontoon-structure clearing house for the supply assembled units to all theaters of the Southwest Pacific

A working Seabee refutation to "It can't be done scoffers, Pontoon Assembly Detachment No. 1 manu factures its pontoons, "ties together" its structures, an supplies ready-to-use, front-line-built "cigar boxes" fo the conduct of the war against Japan.

Official U.S. Navy Photo

PUTTING THE FINISHING TOUCHES ON A TIMBER BRIDGE

Rebuilding Guam's War-Torn Water System

By W. A. LAWRENCE
LIEUTENANT, CIVIL ENGINEER CORPS, U.S.N.R.

BY utilizing battle-damaged reservoirs and water lines, and salvaging other materials both from prewar American installations and from captured Jap construction dumps, Naval Construction Battalions on Guam rebuilt a water system in record time. This was a large municipal-type system supplying daily 2 to 4 million gallons of treated water to strategic shore-based activities, and to large water tankers serving fleet units in the far western Pacific area.

TAKE Guam two days after Marine and Army assault troops had smashed Jap beach fenses and poured ashore by the ousands. Add the Guam rainy ason at its peak, with tropical wnpours and bottomless mud. gain, add rough country and tan- ed jungles, with a liberal sprinkling prowling Jap snipers. Subtract new materials normally used in ilding water systems—such as st-iron pipe, oakum, lead, and ment. Then deduct practically all essential tools, ch as plumbers' lead pots and pipe-handling gear. nally, superimpose on this situation an urgent need for otable fresh water, not only for Guam's tens of thou- nds of garrison troops but also for the big fleet-support ater tankers hovering offshore. And there you have e task set before the men of three Naval Construction attalions early ashore on the shell-cratered beaches of uam.

A certain amount of water had been brought in with e assault forces—enough to give every man a meager 2- l ration each day for his first five days on the island. his water wasn't easy to swallow either; it had come l the way from Guadalcanal in little 5-gal Jerry cans and d acquired en route the odor and taste of an old paint cker. Not but that the thirsty troops were glad to nk it. It was preferable to the fresh-water streams hore in which might lurk anything from dysentery to p-planted poison.

It wasn't many days before the fast-moving Marines d assault-echelon Seabees had established a number of all water points on the island, taking water from pre- ted fresh-water springs and dosing it with chlorine in pious if somewhat unpalatable quanti- es. They also set up several small dis- llation units—little oil-fired stills that cked up ocean water and discharged a ow stream of fresh water at the trickling te of only 80 gal an hour—and this at e high cost of a gallon of precious fuel r every 18 gal of drinking water.

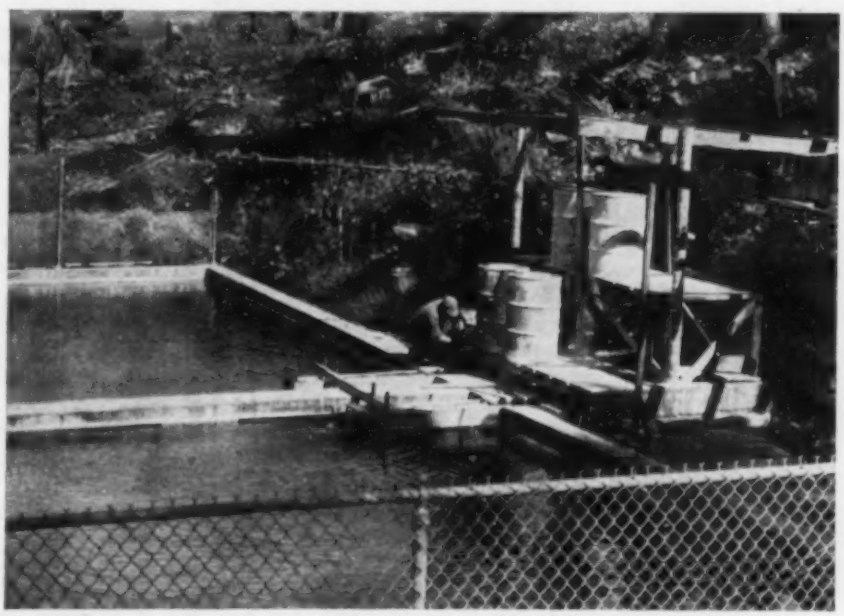
So, on the whole, the troops were get- ng along with just about enough water keep their canteens filled, but none r anything else. Nor were the big water nkers of the fleet able to serve the many oop transports and auxiliary small craft th their much-needed issues of fresh ater from Guam's ample but out-of- each supply.

Fresh water in the forward Pacific areas as long been a serious problem, primarily ecause the tiny atolls captured along e road to Tokyo (such as Tarawa, wajalein, and Eniwetok) yield insuffici- nt fresh water for their own garrisons, th no possibility of supplying the needs the forces afloat. Before Guam's more nerous water supply became available, much of the water for replenishing the thirsty troopships and small craft had to come by tanker the thousands of miles from Pearl Harbor or Guadalcanal. It was to avoid these long costly hauls that the work was pushed on the dock-side water-issuing facilities on the island. And it was to give Guam's water-hungry garrison troops more than a daily gallon or two of fresh water that work was rushed on the entire island water system.

Guam is not the "tiny coral island" many people picture it to be. It is a rather large, rugged area of volcanic and limestone rock, its roughly oblong shape bearing generally north and south in its longest dimension. Its length is about 30 miles, its width ranges from 6 to 12 miles, and its area is 225 sq miles, almost a quarter of that of the State of Rhode Island. Terrain includes hills, valleys, high steep limestone bluffs, and wide sloping plateaus, covered over for the most part by a luxuriant blanket of tropical jungle and swordgrass.

The native population numbers about 23,000 and the military population has already reached a censorable figure of many times that number. The principal island activity centers about strategic Apra Harbor, the main port, situated on the west central side, and around Agana, which before the war was the leading town (of 12,000 people), located a few miles east of Apra Harbor.

Like everything else on this bitterly contested island, the widespread water facilities suffered their full share of destruction. Built by Navy Public Works construction men back in the easy prewar days, Guam's water system had consisted of some half-dozen spring-fed reservoirs spotted throughout the west central hills. Thence cast-



AT AGAT RESERVOIR A TEMPORARY BARREL-TYPE HYPO-CHLORINATOR WAS PUT INTO OPERATION

STANDARD DIVIDING-WALL OF AGANA RESERVOIR PERMITS CLEANING OF ONE HALF AT A TIME

iron water lines had led down to the several towns and villages fringing Apra Harbor and Agana Bay. Although originally installed as a single interconnected utility, the system functioned as two distinct units serving the two principal island areas.

In the south, the Almagosa facilities included the Almagosa Springs, the catch basin, and the Maanot Reservoir, all located high up on Almagosa Mountain. These facilities served the important Orote Peninsula and the surrounding Apra Harbor areas. Downhill and to the west was the smaller Agat Reservoir serving the little village of Agat—scene of the principal Marine landings and smashed into rubble by the initial fighting. In the north were the Agana facilities, including Maina Spring and Agana reservoirs situated on Agana Heights. To the west was the Asan Reservoir, located above Asan.

All these facilities served the city of Agana's prewar population of 12,000. The reservoirs had been sturdily built of reinforced concrete in rectangular form, with the usual dividing wall to permit cleaning of half the structure at a time, all in accordance with good Bureau of Yards and Docks design. Water lines too had been well built, albeit a large part of the cast-iron pipe had been laid in concrete anchor blocks along the surface of the ground instead of in trenches as is normally done. All in all, the prewar water system of Guam had been a good serviceable public utility, far superior to most similar island installations.

It is rather ironical that most of the damage inflicted on the system was done by our own assault forces rather than by the Japanese. Our heavy pre-assault bombing and short-range naval gunfire, followed later by land-based artillery and mortar fire, and still later by intense automatic-weapon and rifle fire, left deep scars on the defenseless reservoirs and water pipes. The hard-pressed Japs as they retreated apparently lacked either the time or the explosives to set off major demolition blasts on any part of the system. But our own efforts along these lines should have more than satisfied the Nipponese love for destruction. When the Seabees took over, the water system was not only damaged—parts of it were almost obliterated.

Over to the east, on Agana Heights, the other half of the island's water system had fared little better. The half-million-gal Agana Reservoir, chief storage tank for that area, had received at least a ha dozen direct shell hits, as evidenced the number of large holes torn thro its 10-in. concrete walls. The 24,0 gal Maina Springs Reservoir, situa above Agana Reservoir, was in such condition that it was later complet abandoned. And the 83,000-gal Ag Reservoir, second main storage point this part of the system, showed t large gaping holes where shells or bom had found their mark, plus numer smaller breaks and fissures caused the fragments of "near-misses." this area too, the exposed pipe li took a terrible beating from bom shells, and roughshod tanks and bu dozers.

The urgent work of restorati started almost as soon as the bea heads were established. Of first i portance was the problem of getti water to the incoming troops at Ag Beach. The next day Seabees i spected the damage to Agat Reserv and lines, just captured by Marines. Returning w salvaged pipe and captured Jap tools, they repaired t broken line and calked the joints with their torn-up soc and undershirts. These makeshift repairs made it pos ble to send water down to the first system-fed water po established next day above Agat.

Following a hurried examination of the overall dama to the Almagosa system, it was decided to put men salvaging as much cast-iron pipe as possible from bran lines so as to be able to construct one usable run (7 mile of pipe from Almagosa Springs to Orote's thousands encamped troops, and also to the big fleet-support wat tankers. At the same time orders were issued to st reconstruction of the Agana system's battered reservo and pump house. The city of Agana had been tak only a day or two earlier, so the entire area was st somewhat in dispute when the Seabees went to work.

There followed the slow, hard work of gatheri enough usable pipe. At first the lengths with bull holes in them were rejected as useless. It soon becam evident, however, that some means would have to b found to repair these sections if the line was to be co pleted. There was no new pipe of any kind or size, a all the usual Seabee materials had been left behind b these assault troops, to be brought in later by oth echelons—too much later to be of immediate use.

Numerous proposals were offered as to how to repa bullet holes in cast-iron pipe, and none met with le enthusiasm than the suggestion that they be plugg with ordinary brazing rod, brazed in with a gas torc However, it worked. Not in one but in hundreds holes, the welder incorporated his little bronze plugs, a useless lengths of pipe became usable.

JAPS PROVIDE MATERIALS

New calking lead, like new pipe, was another critic item made conspicuous by its absence. To get any le for repairing joints on the first 7 miles of rebuilt line, t Seabees were obliged to recover lead from the o joints, by prying the cold metal out of the broken pi bells. Wherever the position of the pipe made it n possible to cold-break the joints, the lead-salvaging cre had to resort to a more primitive but equally effecti method—that of building a small wood fire around ea joint, causing the lead to melt and run out.

New oakum was another necessity ssing on this "bricks-without-straw" oject. Unlike the lead, the salvaged kum was not very satisfactory, so abee search parties set out to find a bstitute. Their search yielded re-lts, too, when in combing over old p material dumps, they came upon ntities of usable calking yarn. ctically every joint on the long ter lines now in service owes its tertightness to this Japanese ma-rial.

When a lead pot was needed, some e suggested a G.I. helmet. And dly enough it did the job, withstood e terrific furnace heat, and proved to just the proper size to accommodate e pouring ladle. (Add one more use the helmet-of-a-thousand-uses.)

Pipe handling gear was another sorely eded item not brought ashore in the ctic early phases of operation. Lack-g tripods and tackle and side-boom actors, the Seabees moved a large rt of the back-breaking 8- and 10-in. pipe by sheer anpower and determination. It was pouring rain much the time, too—rain that chilled the melting lead, nched the little lead-melting fires around the pipe joints, led the open trenches with a flood of water and knee-ep mud, and turned the whole job site into a slippery agmire. Guam takes seriously its reputation for 80 in. rainfall in the four-month rainy season—and this was e rainy season. It was not uncommon to have more an an inch in an hour, and several inches in a day.

One of the natives, working with the Seabees on the pe line, brought in his big, slow, but powerful water ffalo, common beast of all island burdens. Together ey dragged the unwieldy lengths of pipe in and out of e muddy trenches. Incidentally there were many her cases of cooperation between loyal natives and the abees.

Other men of the battalion were busy cleaning and re-iring Almagosa catch basin and Maanot Reservoir. ere again the critical lack of materials was felt, but this me it was cement. And here again the unwitting nerosity of the Japanese, who had left large stores of eir very fine cement behind, filled the need. Concrete for patching the battered reservoir was mixed on the site from materials at hand as aggregate—mostly coral limestone and coral sand. Lacking waterproofing compound, the men dumped liberal quantities of the Japanese cement into the mix. So the rehabilitated reservoirs, like the water lines, owe their impervious qualities to the reluctant generosity of the Japanese. On the shell-torn Agana and Asan reservoirs, as on the Maanot Reservoir, this captured Jap cement was used throughout in making the extensive repairs. Here again coral stone and sand, with copious quantities of this good cement, made a fine impervious concrete that is holding up very well indeed.

SEABEE REPAIR CREW SURVEYING DAMAGED AGANA PUMPING STATION
Jungle at Left Was a Favorite Jap Sniper Hide-Out

GUAM NATIVES AND THEIR WATER BUFFALO HELPED TO PLACE PIPE

REPAIRING THE PUMPS

Repairs to the highly important Agana pumping station called for a special kind of patchwork technique. Initially the station had housed four large electric-drive, centrifugal pumps for lifting water from nearby Agana Springs 200 ft up into Agana Reservoir. When first viewed by Seabee repair crews, the station was in a sad state, having been hit by numerous pieces of flying ordnance ranging from large shells to small rifle bullets. A number of the latter had penetrated the pump casings on the high-pressure or discharge side, and thus had created a ticklish problem in welding or brazing. Luckily none of the bullets had hit the impellers. Of the four pumps, two were repaired by brazing over the bullet holes, and a third was stripped for parts to repair the fourth, so that three of the four pumps were salvaged.

Originally the pumping station had been electrically driven, but the sole source of electric power in large quantities was the Agana Power Plant, smashed to junk by gunfire. So the Seabees turned to their old beachhead friends, the "amtracks." From three of these reef-crawling tractors they salvaged the 130-hp six-cylinder gasoline engines, set them up on improvised foundations placed right over the old motor bases, and proceeded to pump water.

From the standpoint of safe operation, it was fortunate that the pumps could push water up into Agana Reservoir at such high rates, for the station could only be operated in the daylight. Situated near the dense tangle of Agana swamp, the pumphouse was a favorite target for lurking Jap snipers. Their harassing night firing during the early weeks of the occupation made it too risky to maintain a night watch in the pump house.

Below Agana pumphouse lay the city of Agana with its miles of cracked and broken water mains. Repairing these shattered arteries involved a long and weary search for ruptured joints and open service connections. This city, located along the curving shoreline of Agana Bay, received a terrific concentration of short-range naval

TYPICAL SECTION OF SHATTERED CAST-IRON MAIN
Native Workmen Removed Joint Lead by Bonfire

gunfire. Practically everything in the town, including the water-pipes, was either demolished or so damaged as to make repair almost impossible. When pressure was first placed on the system, water spurted from a hundred different outlets—from open corporation cocks and cracked joints. Keeping pressure on the lines was virtually impossible until at least some of the many leaks and breaks were patched. Finally, by the slow process of elimination, the repair crews were able to ferret out enough of the leaks to get at least a part of the old prewar city piping back in operation, thus providing water points at three locations on the outskirts of the town and making it unnecessary for water trucks and trailers from camps north, south, and east of Agana to plow through the rubble of the town in search of water.

The progress of the Seabees in the battered Agana area kept pace with that of other Seabees in the Almagosa region. As a result, on or about September 18, some 59 days after the first assault wave hit the beach, and 39 days after organized resistance on the island had been officially terminated, the major part of a large utility-type water system had been reconstructed by two Seabee battalions aided by survey crews. And this had been done with practically nothing but salvaged materials and the few tools which the Seabees were able to carry ashore on their trip in with the assault troops.

LIVING CONDITIONS LEFT SOMETHING TO BE DESIRED

Through all these grinding weeks, the men lived under what amounted almost to combat conditions. For the first week or two, "K" rations were the order of the day; later the menu included the almost equally unsavory "C" rations, with their two-way gamut of "meat and vegetable stew" and "meat and vegetable hash." During much of the time, hot chow was the exception rather than the rule. Out on the pipe lines, deep in jungles where lurked suicidal banzai-minded enemy snipers, the men never attempted to work unless they had as many more men surrounding them as an armed guard. By good luck and sharp eyes, there were only a few casualties and no deaths. There was enough excitement to keep the guards on their toes, though. For the first week or two the men slept in foxholes, enduring the drowning mud and the discomfort rather than risk being shot by a sniper or a "trigger-happy" Marine sentry. Later they pitched little pup tents—"shelter-halves" that left much to be desired in the way of shelter. Not until the battalion housekeeping gear came ashore weeks later were they able to get out of the mud and into something resembling adequate quarters. Meanwhile they had water lines.

TWO MILLION GALLONS A DAY

As Guam's water system stands today, it would be a credit to any thriving municipality, and it is still growing and improving. At present it includes four spring-fed rehabilitated reservoirs serving two densely populated areas totaling some 20 to 30 sq miles, and more than [illegible] miles of 6-, 8-, and 10-in. cast-iron lines rebuilt to deliver a daily output of treated water in excess of 2,000,000 gal and with a peak system capacity of more than 4,000,000 gal per day—enough treated water for a metropolis of [illegible] to 75 thousand inhabitants. Facilities also include a dock-side tanker line capable of delivering water just as fast as the big fleet tankers can take it. Included also are three pump houses, five chlorination stations, and [illegible] or eight well pumps serving outlying areas.

Water treatment on the system follows the standard municipal practice of using both pre- and post-chlorination. All water is pre-chlorinated by the barrel method whereby the liquor from a barrel of saturated "HTH" (high-test hypochlorite) solution is drained off and fed through a float-controlled orifice into the influent line leading to the reservoir. Influent is dosed to approximately 7 ppm. Post-chlorination injects approximately 2 ppm, to make 9 ppm total chlorination. After the first month of system operation, it was possible to carry residuals in excess of 1 ppm throughout the entire line without creating excessive taste in the water. All residuals were of the "flash" type, which indicated that chlorination was being carried in the desirable "breakpoint" range. After several months of operation, during which the system has served censorable thousands of troops, there has still not been a single case of illness traceable to the water supply.

A SEABEE-IMPROVISED WATER WHEEL

In devising chlorination equipment, the best Seabee traditions of making something out of nothing were followed, the "something" being a small water wheel to drive a post-chlorinator at the Maanot Reservoir. The chlorinator itself had been taken from a portable water treatment unit and had originally been powered by a small gasoline engine. Under the grueling 24-hour operating conditions, however, the little gas engine soon grew tired, leaving the chlorinator without power. So the clever Seabee improvisers went to work on an old "HTH" can with tin snips and soldering iron, and came up with a neat little water wheel. This they drove by a stream of water piped down from above the reservoir, having coupled its shaft to the hypo-chlorinator. And unlike its gas-eating predecessor, the little fractional-horsepower wheel has been spinning ever since with practically no care or attention.

Full credit for the outstanding job of rebuilding Guam's water system goes to officers and men of the Naval Construction Battalions under the general direction of the Naval Construction Brigade commanded by Capt. W. [illegible] Hiltabidle, M. Am. Soc. C.E., CEC, U.S.N. To all those who contributed their courage and skill on this major reconstruction job goes the commendation "well done." Without their contribution, the growth of Guam as an important major base in support of our fleet and ground forces would have been a slower and a less valuable development.

New Military Surveying Equipment

Developed by the Corps of Engineers

By WILLIAM S. LITTLE, ASSOC. M. AM. SOC. C.E.
MAJOR, CORPS OF ENGINEERS, ENGINEER BOARD, FORT BELVOIR, VA.

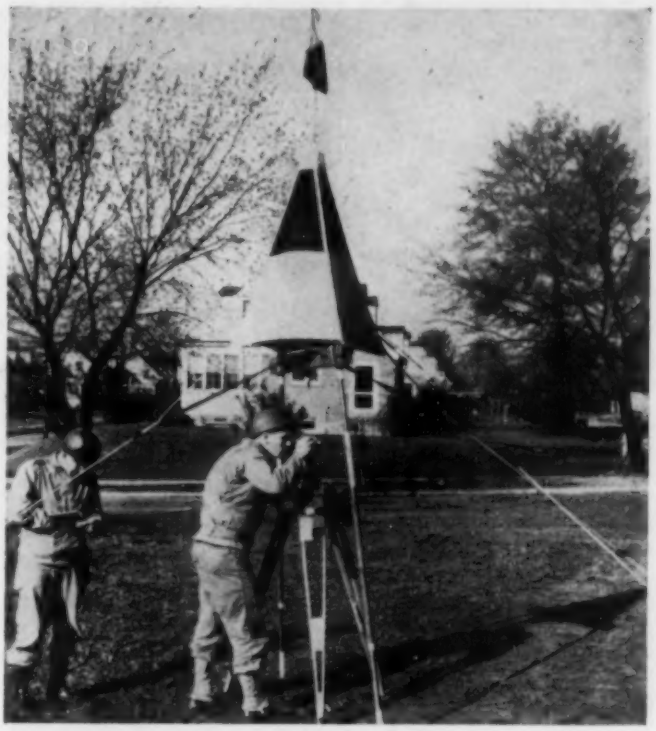
WITH our armies on the offensive in every theater of war, it can easily be seen that numberless observations ust be made to check locations, correct maps, direct artillery , and accomplish many other equally important pro- ures. In many cases special surveying equipment is ded. An observer cannot be left exposed at a station for long period required for the operation of ordinary sur- ing instruments. Many other rigorous conditions are countered. Developing and testing needed equipment the Army Corps of Engineers is the responsibility of the gineer Board. This group of specialists has brought th many improved designs. Several of the more recent truments and accessories of interest to civil engineers described by Major Little in this article.

PART of the work of engineer topographic units in combat consists of establishing control for maps and for field artillery fire control. This involves any kinds of surveying under widely varying field nditions. Conventional methods, sometimes modified meet military needs, are used extensively. These clude triangulation, tape and stadia traverses, plane- ble surveys, azimuth determination, astro-fixes, and fferential, trigonometric, and barometric leveling. ecial equipment and technique are sometimes re- ired to do tasks peculiar to military surveying. Some the equipment that has recently been developed will be scribed.

MILITARY THEODOLITE READING TO ONE SECOND

In military surveying, a light-weight instrument is eded that can be used for turning the angles of a iangulation net in the minimum of time. Any reduc- on in the time required to do field work is extremely neficial, as one of the principal uses of triangula- on nets in combat is to tie together primary artillery ntrol surveys so that fire may be directed as early as ssible on a common target by any combination of tteries within range. As the observer may be an ex- llent target for enemy observers and snipers and for her fire, it is desirable to use an instrument that can read quickly a couple of times to get sufficiently ac- rate results. Formerly the Army used the foreign- de Tavistock and Wild theodolites, but these were no nger available after the war started. Even before at time, the Corps of Engineers had recognized the ed of developing manufacturing facilities for this type instrument in the United States, and steps were taken secure pilot models from American surveying instru- ent makers.

The theodolite shown in an accompanying photograph the first of the models now in production. It was ilt by the W. and L. E. Gurley Company, of Troy, ew York. The telescope optics were designed under NDRC project, and the circles were graduated by the S. National Bureau of Standards. This theodolite is a



PORTABLE SURVEY BEACON HAS FLUORESCENT CLOTH FOR UNUSUAL BRILLIANCY

directional instrument of the optical coincidence type, reading directly to 1 sec. Tests on fixed collimators show that the instrument is at least equivalent in accuracy to the similar foreign-made theodolites tested, and probably more accurate. It is similar in principle and operation to the small Wild theodolite.

SYSTEMS OF PRISMS USED

The circles are stainless steel, 4 in. in diameter, graduated every 20 min, and numbered at every degree. Reading is made through a microscope mounted rigidly on the right-hand side of the telescope and is accomplished by a system of prisms which brings together the images of the graduations from directly opposite sides of the circle. Another system of prisms, actuated by a knurled knob, is used to bring the two sets of graduations into apparent coincidence. When perfect coincidence has been obtained, the degrees and even 10 minutes are read from the circle against a fixed index line in one part of the reading microscope field.

In another part of the same field, the additional minutes and seconds are read on a scale 10 min long, which is connected to the prism system in such a manner as to divide a 10-min interval on the main circle into exactly 600 sec. A two-position knob which moves another prism provides for reading, by the same microscope, either the vertical or the horizontal circle. Provision is made to set the horizontal circle at any position by another knob through a gear train which can be disengaged to prevent accidental derangement by the operator.

The altitude level bubble is read from the observer's normal positions through a prism system. Half of each end of the bubble, split longitudinally, is seen in the field so that when the ends are made to coincide by moving the vial, it is perfectly level. An optical plummet for use on towers or on the ground is furnished in addition to the plumb bob. The electric illumination system provides for night operation and is so designed that very

THEODOLITE DEVELOPED BY ENGINEER BOARD READS DIRECTLY TO ONE SECOND

little stray light is visible. At 100 yd the instrument can be operated without being seen, except by a person directly in line with the telescope, who may detect a faint glow from the reticle at a slightly greater distance.

The star sights, the plate level, and the circular level on the tripod are illuminated by radioactive material so that they can be used at night to full advantage. Power is supplied from a battery case strapped to one of the tripod legs. A watertight metal case, with rubber shock-mounting for the instrument head, is furnished, as well as an outer wooden packing case padded for further protection. All accessories and tools are packed in the metal carrying case or in another small metal container.

A capsule is clipped to the inside of the metal carrying case, containing a desiccant to keep the instrument head dry in the excessively humid conditions found in the tropics, or to prevent excessive condensation resulting from sudden temperature changes. The desiccant contains an "indicator" which changes its color from blue to purple when the ambient humidity becomes too high. A spare capsule is furnished for use if needed; or the original can be dried out slowly in an oven and used again. Every effort has been made to make the outfit weather-proof. A special pack is provided for back packing the instrument head in its metal carrying case. This is made principally of light-weight metal tubing welded together.

SEMI-PRECISE MILITARY LEVEL

Another instrument specially designed to meet military needs is the semi-precise level built by C. L. Berger and Sons, of Boston, Mass. Its purpose is the quick accomplishment of second-order and third-order differential leveling. It is a tilting, dumpy-type instrument with differential vertical tilting screw and means for reading the level bubble from the eyepiece end of the telescope. It is fully night illuminated by an electric lighting system which can be detached for daytime use. The telescope, of the internal focusing type, is inverting and is furnished with a glass reticle. The telescope is tilted about a lateral pivot located directly over the spindle by means of a differential tilting screw placed under the eyepiece end of the telescope.

A universal (circular) level vial, mounted on the base of the instrument, allows approximate leveling of the head; final leveling is accomplished by tilting the telescope so that the two ends of the main level vial, as seen through a reading microscope mounted on the left-hand side of the telescope, are brought into coincidence. The bubble is "split" by a prism system similar to that used for reading the altitude level in the theodolite previously described. When coincidence is obtained, the rod may be read.

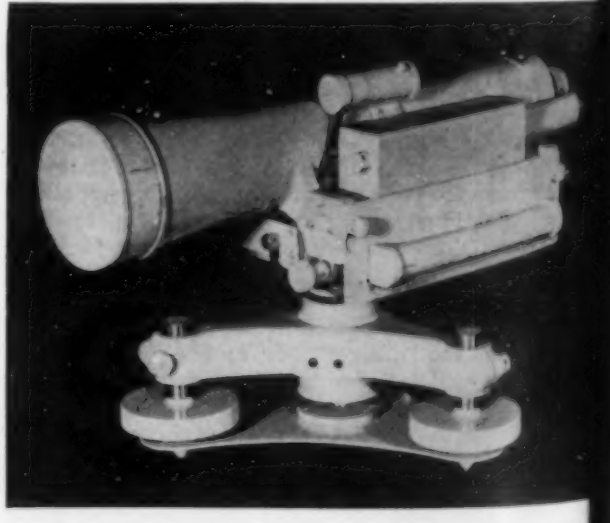
With this instrument, setups can be made very rapidly. When used at night, the instrument shows very little stray light, being invisible at about 200 ft. The glass reticle in the instrument is permanently fixed in an accurately made cell, which can be replaced easily. A positioning pin insures that the new reticle will be in the proper position in the instrument, and no further adjustments need be made except that of the main level vial by the usual "peg" method. Power is furnished from three flashlight batteries in a separate watertight case.

All tools, accessories, spare bulbs, and a spare level vial and reticle cell are packed in the carrying case, which is made of mahogany. The tripod is made of oak and is of conventional design. Many other design features, too numerous to mention here, contribute to the ease and speed of operation of this level.

PENDULUM ASTROLABE OR EQUIANGULATOR

A new instrument, the 60° air-dampened pendulum astrolabe (or "equiangulator") has been invented by John E. Willis, formerly of the U.S. Naval Observatory. The pilot model of this instrument was built by the Dave White Company, of Milwaukee, Wis., and this firm is now producing it in quantity. It is used in conjunction with a chronometer, a stop-watch, and radio time signals for getting astro-fixes to within about 200 ft, for the ground control of maps and charts in areas not controlled by survey or previous astro-observations.

The accurate time of transit of a star across the



MILITARY LEVEL DESIGNED TO QUICKLY ACCOMPLISH SECOND AND THIRD ORDER LEVELING

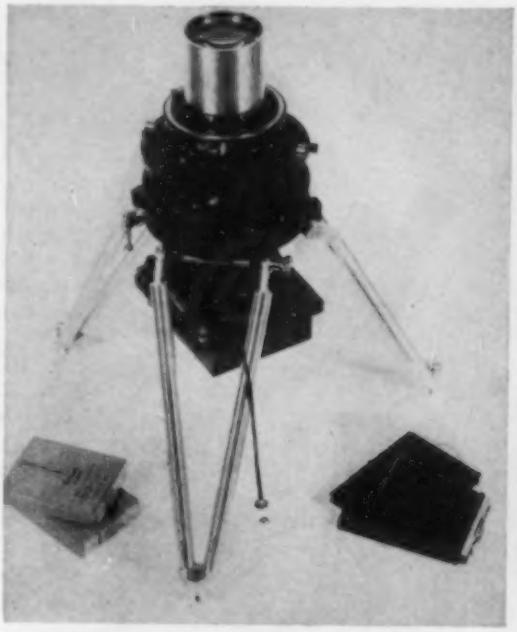
itude circle gives a "line of sition" to within a few onds of arc. Several "lines position," at evenly spaced imuths around the horizon, e a fix. This is similar to "line-of-position" fix thods in navigation, using assumed position. How-er, more stars are used, re rigorous formulas are ployed, and the computa-ns are carried out to more nificant places.

As long as the instrument dicates the star's transit at ctly the same altitude dur-g a series of observations one fix, no matter in which imuth the astrolabe is nted, the altitude angle s not have to be exactly °. No correction need be de for refraction, as the itude angles are all equal, uming that changes in air nperature and pressure re-in nearly constant, or are too small to affect the re-ting fix.

This astrolabe consists of an 80-power telescope "split" that the optical axes of the objective lens and the epiece assembly lie in the same vertical plane and are se to 30° from the vertical axis of the instrument, but opposite sides. An accurately ground surface mirror, unted horizontally on an air-dampened pendulum, is ated at the intersection of the two optical axes so as to lect rays from the objective back up into the eyepiece embly, which contains a glass reticle.

MIRROR REPLACES MERCURY

Except for the use of a mirror mounted on a pendulum, s device is similar in principle to the de la Baume uvinel bent telescope astrolabe, which employs mer-y instead of a mirror. However, a very slight change the height of the mercury in the bent telescope astro-e will change the apparent altitude of a star, which kes it impractical for field use. The fixed length of pendulum eliminates this as well as all the difficulties and nuisances of using mercury. The pendulum is hung on a thin double-cantilever spring-suspension system that allows swinging fore and aft, and also sideways. Fore and aft displacement of the mirror stage by reason of action of the lateral suspension springs, when the instrument is slightly out of level, is compensated for.

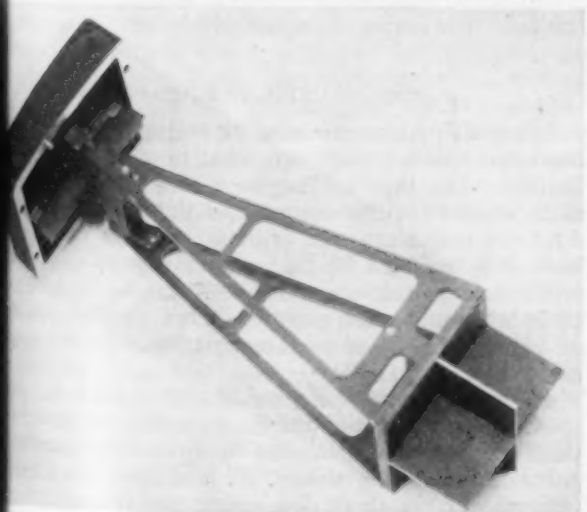


ZENITH CAMERA ASCERTAINS LOCATION BY PHOTOGRAPHING STARS NEAR THE ZENITH

ALTIMETER USED BY ARMY FOR ELEVATIONS TO WITHIN AN ACCURACY OF 10 FT

Air dampening is accomplished by means of two vertical fins fixed to the bottom of the pendulum stage, placed vertically and at right angles to each other, in the form of an "X" when viewed from below. Corresponding plates spaced $^1/_2$ mm from each side of each face of the pendulum fins are fastened to the base of the instrument proper. The resulting thin air spaces act like a viscous fluid and effectively dampen the swing of the pendulum so that it comes to rest in about 6 sec of time after the instrument is disturbed—as in pointing at a new star. This is at least as quickly as a bowl of mercury will come to rest in the conventional astrolabe.

The base of the instrument consists of a conventional leveling head and an azimuth circle similar to that in balloon theodolites. The circle is graduated to even degrees and serves to point the instrument at the proper stars, as listed in the 60° star tables. A trough compass is used for preliminary orientation. A low-power finder is provided to help locate and identify stars. A tripod and all accessories are also furnished.



PENDULUM OF ASTROLABE IS SPRING SUSPENDED AND AIR DAMPENED FOR RAPID DAMPENING

ACCURACY HIGH

Tests show the pendulum astrolabe to be as accurate as the conventional prismatic instruments and probably more so. It is less than half as heavy, is easier to build, and costs about one-fifth as much to produce in the United States as the equilateral prism instrument. It is also easier to operate and will function below the freezing point of mercury.

For several reasons, full advantage is not taken at this time of the potential instrumental accuracy of this model of the astrolabe, which is on the order of 0.1 sec of arc. The deflection of the vertical cannot be measured in the field directly, is unpredictable in direction or magnitude, and may cause many hundreds of feet of difference between a geodetic and a corresponding astronomic posi-

tion. Only a triangulation net covering a large land area and tied to many stations whose astronomic positions have been accurately determined, will give the values of the plumb variation with any degree of certainty.

As has been indicated, the military use of astro position-finding equipment is to get the best possible control where no basic survey control exists, and where it is impracticable to establish it. An example of this would be for the immediate control of aerial photomaps and charts of remote land areas where astro-fix parties could operate, but where field surveys would be impossible or not feasible. Further refinement of an astro-position good to 200 ft or better is not warranted, since much larger errors usually exist as a result of the plumb variation, which cannot readily be isolated. Also, the scale of the map or chart being prepared is usually so small that an error of 200 ft cannot be plotted. Further considerations include the extreme difficulty of getting time in the field more accurately than to about 0.1 sec, and the fact that the simpler and lighter this type of equipment is, the better suited it is for Army field use.

PENDULUM ASTROLABE MEASURES TIME OF TRANSIT OF A STAR ACROSS THE 60° ALTITUDE CIRCLE

There is little doubt that, with refinements in observing, recording time, computing, and eliminating personal errors by photographic or mechanical means, this instrument will have extensive and important peacetime use in applied astronomy.

ZENITH CAMERA DEVELOPED FOR MILITARY USE

The pilot model of the 12-in. focal-length Zenith camera, shown in an accompanying photograph, was developed for the Army Air Forces to get ground control directly by photographing the stars near the zenith. The camera is set on the ground, carefully leveled, and two exposures are made, the camera being rotated 180° ± 1′ for the second exposure without disturbing the instrument. Exact time is taken of the mid-point of each exposure. The star images on the photographic plate are then measured on an accurate comparator, and the position of the zenith is computed from the known relative positions of the stars and the time of exposure. The position of the zenith with respect to the equator and the prime meridian is, of course, the astro-fix of the camera.

Tests indicate that astro-fixes good to about 300 ft may be obtained with this camera. The advantages of using this method for astro-fixes, as against the transit, theodolite, or astrolabe, are (1) that all that is required is a few degrees of clear sky at the zenith; and (2) that the station need not be occupied for several hours, a procedure which is necessary with other methods, and may be undesirable in military operations. Disadvantages include the fact that it takes considerably longer to compute the fix and that the computations are not self-checking. Only a complete computation of another plate exposed at the same location will guarantee against the innumerable chances for error in this type of solution.

Also, plates must be develo in the field before leaving station to insure that good posures have been made. T is often a difficult proced The pilot model shown was b by David W. Mann, of Linc Mass. Another successful perimental model of somew different design was made by Eastman Kodak Company, Rochester, N.Y.

SURVEYING ALTIMETER

Use of the altimeter (aner barometer) for determi elevations in mapping is ap cable to military surveys wh accuracies to within 10 ft needed. The Army uses instrument at a fixed station known or assumed elevation one or more altimeters for g ting the relative ground ele tions within a radius of about miles of the "base" instrume Comparisons between alti ters for calibration purposes made at the start and at t end of a run. Readings on the instrument and on t thermometer are taken every five minutes on the b instrument and similar readings are made at some e 5-min interval on the other altimeters.

All watches are synchronized at the beginning and the end of the run so that corrections can be made to t individual readings to counterbalance changes in mospheric pressure for the whole area being survey It is assumed, of course, that these changes are consta for the area. Corrections for temperature are made fr a nomograph in the lid of the instrument. Closure er are prorated over the circuit.

While more precise results are obtainable by m elaborate procedures, the method outlined is sufficie accurate for many military purposes. Further refinem in method or equipment is not considered desirable military use. The altimeter is manufactured by Wall and Tiernan Products, Inc., of Belleville, N.J., and re up to 6,000 ft in 10-ft intervals. Another similar mo is furnished, reading to 15,000 ft at 20-ft intervals. the field it is carried in a rain-shedding canvas carry case.

SURVEY BEACONS OF PORTABLE TYPE

A portable survey beacon for use in triangulation b been developed, copied somewhat from that used by t British. The unusual feature is that fluorescent sig cloth is used for the canopy and the flag. On overc days the colors are still brilliant and easily seen. T beacon is designed so that an instrument can be us under it, and electric signal beacons can be clamped to t cross-beam under the canopy. These serve as foresig at night, and under certain circumstances are used advantage in daylight.

The work of developing and testing methods and equ ment for the Corps of Engineers is the responsibility the Engineer Board, headed by Brig. Gen. John W. Schulz, President, with Col. W. J. Matteson as Execut Officer. The work of developing and testing survey equipment is the responsibility of Maj. W. C. Cu Chief of the Mapping Branch, and of the writer.

Federal Legislation to Reduce Water Pollution

By BRENT S. DRANE, M. AM. SOC. C.E.
WASHINGTON, D.C.

EVENTS that shaped the course of federal legislation for the prevention of water pollution during the past ten years had their beginning in the program of emergency public works for the relief of unemployment. The next step was taken in the Ohio River Valley, where because of the widely recognized need for stream pollution control, civic interest quickly developed into an active program at Cincinnati. The cooperation of a number of civic agencies culminated in a resolution by the Health Committee of the Cincinnati Chamber of Commerce, which urged the other river cities of the Valley to join in requesting federal aid to abate pollution. A suitable committee on stream pollution was soon in action. In a report in December 1935, this advisory committee presented drafts of proposed federal legislation, with its opinion that such legislation should provide for cooperation between the states and the federal government in regional planning, but that the actual construction of projects should be done for the most part by cities and by political subdivisions. The Barkley-Hollister Bills, introduced in the 74th Congress in March 1936, were based on the recommendations of this committee.

When the Conference of State and Territorial Health Officers met in April 1936, it expressed its position regarding proposed stream pollution legislation in a resolution which set out specific recommendations. This resolution was followed by the introduction of a bill by Congressman Fred Vinson which incorporated the acceptable parts of the Hollister Bill; and at subsequent hearings the support of the Hollister Bill was transferred to the Barkley-Vinson Bill. Opposition developed, however, from those who favored federal regulation of stream pollution, of whom Senator Lonergan of Connecticut was representative.

Late in 1934 Senator Lonergan had sponsored a Washington conference on stream purification problems, which was held in the Office of the Secretary of War and attended by over thirty persons invited as "experts and leaders believed to represent a cross section of the general views of the entire country on this subject." This conference did much to center Congressional interest in federal legislation for stream pollution control. But its committee of five, appointed to draft plans for legislative procedure, failed to agree, and majority and minority reports were filed. The majority report favored legislation which would provide for unified federal leadership, but opposed an attempt to obtain legislation which would provide for federal control of stream pollution regardless of state consent. The minority report asserted the supremacy of the federal jurisdiction. Subsequently, a bill representing the minority view was introduced by Senator Lonergan. In the resulting conflict of Congressional views no legislation was enacted.

These conflicting opinions were reflected in the many bills that subsequently were introduced into Congress. The difference between the two approaches has been succinctly expressed in the statement that the one type of bill proposes to enlist federal aid in the control of water pollution, while the other type is directed to the enlistment of federal authority to prevent pollution. The first would aid state authority, while the other would make the federal government responsible for the prevention of pollution.

A bill providing the type of legislation favored by the Conference of State and Territorial Officers (H.R. 2711, 75th Congress) was later passed by both houses of Congress, but was vetoed by the President owing to administrative procedures specified in the bill which he found to run counter to a basic principle in the National Budget System. The 75th Congress has the credit also of providing the authority and the funds for the Ohio River Pollution Survey, the most detailed large-scale regional study of water pollution and its control thus far undertaken in the United States. The results of this survey became available early in 1943.

Bills representing both of the already-described opposing viewpoints were introduced in the last (78th) session of Congress, but died in committee with the termination of that session.

At the present time (March 28, 1945) there are three bills before the 79th Congress:

1. *H.R. 519, introduced January 3, 1945, by Mr. Mundt (with its companion bill, S.535, by Senator Myers).* This bill provides for a National Board of Water Pollution Control consisting of the Secretaries of Interior, Agriculture, War, Navy, the Surgeon General of the Public Health Service, and the chairmen and ranking minority members of the Senate Commerce Committee and the House River and Harbors Committee. Under the Board it provides for an operating commission of nine members to be appointed from seven designated federal agencies. The commission is directed to classify the navigable waters of the United States into sanitary water districts generally conforming to watershed areas, and to fix standards of cleanliness for their navigable waters and minimum requirements for treatment of polluting material before its discharge into such waters. It declares it to be the policy of Congress to encourage state and interstate-compact agencies to exercise their statutory authority to prevent and abate pollution, and to take action through the Federal Board only after such existing authorities have been given opportunity to act. The bill further declares the discharge, directly or indirectly, into navigable waters of the United States, of polluting substances injurious to human health or to any form of life, in violation of regulations promulgated by the Board, to be a public and common nuisance, to be prosecuted by any U.S. Attorney upon the request of the Board.

2. *H.R. 592 introduced January 3, 1945, by Mr. Spence.* This in its major aspects is consistent in principle with the vetoed bill which was passed by the 75th Congress in 1938, but it incorporates provisions designed to eliminate the objections which then called for its veto. It establishes responsibilities and duties relating to water pollution control in the Sanitary Engineering Division of the Office of the Surgeon General, U.S. Public Health Service. It provides for further development of federal-state cooperation to include assistance in promoting and planning of needed sewage treatment plants for postwar construction. It emphasizes the importance of producing maturely developed plans well in advance of construction, and the importance of developing local interest in, and support for, pollution abatement programs. It proposes immediate grants-in-aid to municipalities on the recommendation of state health departments for the

purpose of preparing engineering reports, plans, and specifications for postwar construction; and it proposes authorization of federal appropriations for grants-in-aid or loans on a 50–50 basis for postwar construction.

3. *H.R. 587, originally introduced January 6, 1943, and reintroduced January 3, 1945, by Mrs. Smith of Maine (with its companion bill, S330, by Senator White).* This bill is, in effect, a combination or compromise of the provisons of H.R. 592 and 519. While placing the administration of the new law under a Division of Water Pollution Control in the U.S. Public Health Service, rather than under a combined interdepartmental-Congressional board, it is like the Mundt Bill in providing for the fixing of standards of water quality by federal authority and in providing that a failure to maintain the standards of water quality so fixed shall constitute a "public and common nuisance"; court action in the name of the United States to abate such pollution being made the duty of the appropriate U.S. District Attorney, after the expiration of three years from the date when the Act takes effect.

Preparatory to forming a judgment as to the responsibility of the federal government toward the control of water pollution, the thoughtful citizen probably will be interested in conclusions reached by experienced administrators in this field as the result of the two most comprehensive studies which have been made of the subject. From the first of these there is available an excellent summary of the facts which are fundamental to a judicious consideration of the public policies involved in controlling water pollution on a national scale. This summary presents the concurrent findings six years ago of a committee which included heads of agencies, federal and state, concerned with water pollution in the United States. The committee was aided by representatives of many state agencies, and of many non-governmental conservation and industrial agencies, representing altogether a wide variety of viewpoints. The committee report was published early in 1939 as House Document No. 155, 76th Congress, 1st Session, under the title, "Water Pollution in the United States." In all main essentials the report probably is as authoritative and as applicable now as when published; and years may elapse before circumstances again produce so comprehensive a document.

The research of this committee convinced it that public health will always be the basic consideration in pollution abatement. At the same time it was convinced that the relative importance of wild-life, recreational, and general esthetic considerations is likely to increase. For our present purposes, the most valuable part of the Committee's report consists in its conclusions concerning the four factors which it found essential to efficient progress in pollution abatement, as follows:

1. Current research is found deficient both in scope and in correlation. While methods of treating domestic sewage are well developed, continued research should show even more satisfactory and economic methods of treating industrial wastes; the admirable achievements from coordinated research by the pulp and paper industry are a conspicuous example of the possibilities in this direction. The effectiveness of studies in progress by industry and by the many state and federal agencies would be advanced if the duties of stimulating and coordinating such research activities were assigned to a single agency.

2. Education contributes powerfully to an important motive force toward pollution abatement—public opinion. Recent experience has many times shown that unless the people responsible are convinced of the need for remedial works, neither threats of legal action nor offer of financial aid will make them act.

3. Finances are a controlling factor in the abatement of water pollution. Financial cooperation by federal and state governments, in the form of loans or grants in aid, is necessary to bring about a satisfactory rate of progress. Given such cooperation, continued activity by municipalities seems assured.

4. Administration of pollution abatement is a function best performed by state and interstate agencies.

The committee report sets forth specific recommendations, in accordance with these four conclusions, for new state and new federal legislation. These reflect the committee's mature conclusion that federal action should look to the improvement of state enforcement; to research and education; to the stimulation of inter-state compacts and agreements; to the promotion of integrated basin-wide plans; and to financial aid in the form of loans and grants to deserving projects.

A second significant report on water pollution was published in 1943 as House Document 266, 78th Congress, 1st Session. This was the report of the Ohio River Pollution Survey authorized by Congress in the Rivers and Harbors Act approved in August 1937, and carried out by the staffs of the Corps of Engineers, U.S. Army, and of the U.S. Public Health Service, under the direction of a committee of three—a general of the former, a senior sanitary engineer of the latter, and a non-Government expert on stream pollution problems. The findings of the Ohio Valley Committee are, manifestly, most important in this review of public policy in connection with the findings of the earlier advisory committee which have just been reviewed.

After outlining its recommended program—construction of pollution-abating works, reservoir operation, and investigation of means of keeping acid mine drainage out of streams—the Ohio River Committee gives its recommendations under two heads—"State Cooperation" and "Federal Participation." Under the former, it recommends three specific assignments to the commission of state and federal representatives which would be established by the Ohio River Valley Water Sanitation Compact—an interstate agreement whose negotiation by the Valley States is now almost completed.

1. It would have the Interstate Commission take control over all existing and future sources of pollution which affect the normal usage of water in another state.

2. It would have the Commission determine and designate the usage of all streams in the basin, including those intrastate in character, and advise the proper state agency of their findings and decisions, but not issue orders for intrastate streams except when their pollution adversely affects the normal use of water in another state.

3. The Committee recommends that the Interstate Commission process all applications for federal aid and forward all data, together with its recommendations, to the U.S. Public Health Service for the necessary federal administrative action relative to such aid. The Committee recommends that the states develop local procedures for administrative, political, and fiscal programs which would facilitate the installation, maintenance, and operation of treatment plants; and it states that the development of sewerage districts, city-county integration, and other such activities by the states are virtual prerequisites for successful pollution abatement.

Under the head of "Federal Participation," the Committee makes one group of recommendations contingent upon the satisfactory fulfilment of state cooperation as just outlined; and it makes four other recommendations unconditionally. On the condition of state cooperation

recommends that the U.S. Public Health Service be authorized to make grants and loans to states and municipalities to assist in financing the cost of pollution abatement projects; and that in acting upon all requests for allocation of federal funds the Public Health Service give preference to those which are essential for the protection of the public health and navigation.

The Committee recommends, unconditionally, that the Director of the Bureau of Mines be authorized to complete a specific (1940) mine-sealing program, to inspect and maintain all existing and newly constructed mine-seals, and to investigate means of further reducing the amount of acid reaching the streams from the mines.

It recommends that Congress authorize an annual appropriation to the U.S. Public Health Service to cover the costs of reviewing and acting upon requests for allocation of federal funds to finance abatement projects, of supervising the actual construction of the projects to insure the protection of federal interests, of conducting research to find more economical new methods of waste treatment, and of informing the public on the need for pollution abatement. It recommends that the Public Health Service be authorized to use an appropriate agency of the government, designated by the President for the purpose of reviewing the title, location, plans, and specifications for treatment-plant construction, and of supervising actual construction

This review of the most comprehensive studies of the problem shows that public authorities, state and federal, which have been most responsible for public control of water pollution, are of one mind that satisfactory progress will depend most of all on neighborhood enlightenment, and the better local and state law and administration which will follow. They show no doubt that under those conditions individual communities would operate their abatement facilities in full accord with broad regional and national interests. They are unanimous that the federal government can contribute to progress most successfully by stimulating and reinforcing state initiative and action, not by taking the responsibility away from the states and enforcing federal regulations upon them by an army of federal inspectors and police.

Engineers' Notebook

Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Sewage Outfall Line Floated Into Place by Seabees

By J. DUNCAN CAMPBELL
CARPENTER'S MATE, FIRST CLASS, U.S. NAVY

ON a recent assignment in the Central Pacific, a Seabee Construction Battalion solved a very intriguing problem with ingenuity and dispatch. A sewer outfall line pouring a million gallons of raw sewage into the nearby lagoon every day was creating an unhealthy situation along adjacent beaches. The battalion floated heavy, 16 in., ball-joint, cast-iron pipe into place. Engineers may find the story a useful guide.

It had been determined that, if the sewage were discharged at a point 2,000 ft from the shore, a current would carry it out to sea through a natural channel in the reef. Enough pipe had been ordered and was on hand. The battalion was simply told to go ahead and lay it.

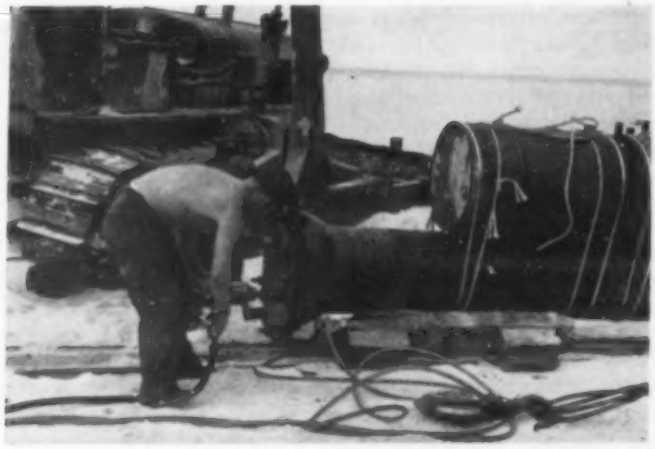
A study of conditions at the site revealed that this might be a great deal more easily said than done. Since the reef was some three miles out, it was easy to understand why the usual onshore winds created sizable waves within the lagoon itself. By the time these got to the beach they were big enough to make surprisingly heavy surf. To complicate matters still more, it was discovered that these onshore winds created a hydraulic head inside the reef, which caused a treacherous side current that ripped along at four knots an hour.

It was patent that this surf would hamper, not to say completely disrupt, launching operations on the beach. To cap the climax, it was proved that no large vessel could negotiate the area in which the pipe was to be laid—it was much too shallow. In fact, the pontoon barge that was used as a tender, which had an outboard propulsion unit, was constantly whanging its rudder against the bottom.

The aerological officer was consulted. He frowned. His records showed that very rarely did two days of calm weather, with light offshore winds, show up in succession! Therefore a method of getting the very heavy pipe into place, from the shore, had to be devised. The method had to click. The whole operation had to be consummated with the utmost speed, once the weather was right, lest the wind shift and whip up heavy rollers that would pound things to pieces.

Fortunately, the lagoon bed was fairly level and sandy. Only one coral head, about 30 yd across, lay in the path of the projected pipe line. Through this obstruction, 30-lb charges of 60% dynamite, strung along the line at about 6-ft intervals and detonated simultaneously, blasted a rough trench.

PIPE SECTIONS WERE BOLTED TOGETHER IN 250-FT LENGTHS
Four Oil Drums Were Banded to Each Section



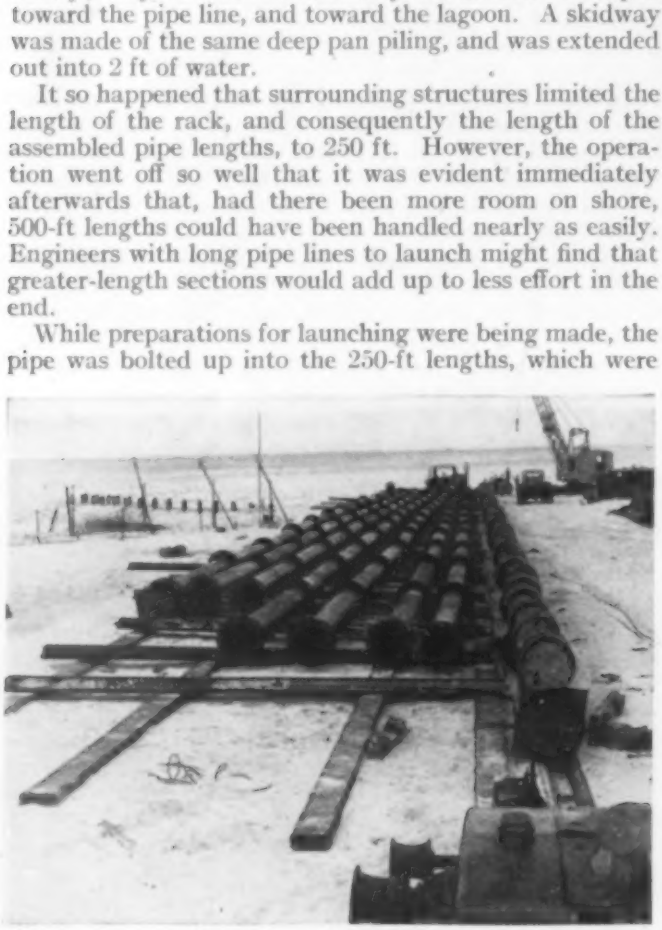
ENDS OF PIPE WERE BULKHEADED AND EACH ADDITION TO LINE TESTED FOR LEAKS

The pipe weighed approximately 169 lb per ft. It was obvious that a special staging would be required to handle it, not only because of its great weight, but because, to launch it speedily, with no hitches, some means of keeping everything primed and organized would be essential. It would not be possible to stop the operation in the middle and wait out bad weather. Once the Engineers began it, they would be committed to the whole job. As it worked out, the plans were well laid.

The staging was built quickly and impermanently, by laying 4 by 12-in. timber stringers parallel to the pipe line. Some salvaged deep-pan piling sections were handy; they were laid transversely. The rack was sloped toward the pipe line, and toward the lagoon. A skidway was made of the same deep pan piling, and was extended out into 2 ft of water.

It so happened that surrounding structures limited the length of the rack, and consequently the length of the assembled pipe lengths, to 250 ft. However, the operation went off so well that it was evident immediately afterwards that, had there been more room on shore, 500-ft lengths could have been handled nearly as easily. Engineers with long pipe lines to launch might find that greater-length sections would add up to less effort in the end.

While preparations for launching were being made, the pipe was bolted up into the 250-ft lengths, which were placed side by side on the ramp. Cranes and "cats" had just enough room, in the area allotted, to maneuver back and forth, lifting the pipe into place.



SECTIONS WERE MADE UP ON STAGING RAMP, THEN ROLLED ONTO SKIDWAY FOR CONNECTION IN LINE

The first assembled length was bulkheaded off at both ends with a $\frac{1}{2}$-in. steel plate, and tested for leaks with 15 lb of air, applied through a 2-in. tapped connection in the rear plate. As each length was launched and a new one moved onto the skidway, the "cat" and crane at the shoreline jockeyed the ends together for easy coupling. The plate, naturally, was moved to the rear each time and the air re-applied to the longer length.

To maintain the pipe's buoyancy in the water, a very obvious and almost ludicrously simple method came to mind, when an available stock of oil drums was remembered. The drums were carefully sealed, and four were banded to each piece of pipe between joints. Ordinary packing-box bands and banders were used. The drums were tied with light rope as an added precaution.

Meanwhile two 3-ton Navy-type anchors were placed a short distance beyond the proposed end of the line from a barge. A snatch block was secured to these anchors, and a $\frac{3}{4}$-in. cable was run from a tractor on the beach, through this block, and back to a fastening on the

AS LINE WAS EXTENDED INTO THE LAGOON, NEW SECTIONS WERE "HORSED" INTO POSITION WITH TRACTOR AND CRANE

front bulkhead on the first length of pipe. The tractor kept strain on this line at all times, but it did not "pull" the pipe into the lagoon with it. The one line and light anchors patently wouldn't stand the strain of drawing the heavy lengths into the lagoon, even though only one length rested on the skidway at a time—the rest was always water borne.

So a three-drum winch was set up to the rear of the skidway. From this two lines were run forward, and through blocks secured to two tractors, which acted merely as dependably solid and easy-to-install deadmen at the water's edge. The cables were then brought back to a clevis on the steel plate on the rear of the pipe length. The winch actually "pushed" the pipe into the lagoon by taking in these two lines. The tractor simply kept the headline taut to guide the pipe to a point near the submerged anchors at the end of the line. Although the side current bellied the pipe somewhat, the tractor operator was able to keep good control of the pipe in general direction. All eight lengths were launched without mishap.

The pipe was then pushed into place over the blasted hole in the coral head, and straightened out as much as possible. The drums were removed from the forward end and back toward the shore, in order. The pipe sagged neatly to the lagoon floor. The ball joints, each with 15 deg of play, permit a considerable curve. Two 6-ton concrete anchors were placed at 200-ft intervals along the

nken line, and one was placed at the end. The job was mplete.

If the battalion had it to do all over again, they would ake only two changes. First they figure it would have id to place small concrete footings to keep the skidway om getting out of alinement. Second, it would have en faster to use another winch to pull in the headline, stead of the tractor. Since there was so little room for e tractor to move, it was necessary to use chokers and shorten the headline after each length was launched, hich was a "pain in the neck."

This is the first time engineers in this vicinity have heard of anyone laying cast-iron pipe this way. In this instance its selection seems justified: it is considerably more resistant to the corrosive action of sea water, and despite difficult conditions, it was launched with great ease and startling speed.

The preparations consumed ten days. The launching took twelve hours! The men looked at each other with surprise after it was all over. The job had been completed in such short order that they felt sure they must have forgotten something.

Timber Towers of a California Suspension Bridge Replaced with Steel

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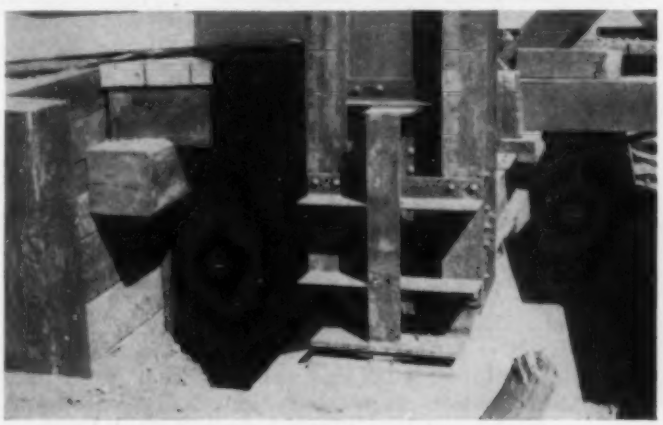
N 1929 the Bridge Department of the California Division of Highways built a 322-ft suspension span er the North Fork of the American River near Auburn, the Mother Lode Highway to Forest Hill, Georgetown, and Sonora, Calif. Timber towers were used because the structure, a one-way bridge with a 12-ft clear adway width, was considered to be in a temporary location. The state highway, a part of the secondary highway system, lies in a proposed reservoir site. This oject was to have been completed by 1942, which lowed the span an estimated useful life of about 12 ars. However the present national emergency postoned the work, and the timber towers were called upon r service far beyond normal expectancy. Imminent ilure due to dry rot and decay made replacement cessary.

SERVICE MAINTAINED

As it was impossible to close the bridge during repairs, plan was devised to jack the saddles supporting the two ables on to new steel towers designed to support the mbined dead and live load of 252,000 lb per saddle. ach saddle represented a dead load of 134,000 lb. Concrete footing block extensions, fastened to the existing otings with 3-unit cinch anchors, were cast under the wer legs.

To receive the saddles from the timber A-frames, the ew steel shafts had to be threaded through the timber ame. Obviously it was not possible to set the steel hafts to coincide exactly with the timber supports at the saddles. Therefore the plan evolved was to set the shafts with the head ends outside the timber head blocks, shift the saddles from the timber to the steel, remove the timber, then rock the steel shafts into place, and rivet the K-frame bracing of the steel towers.

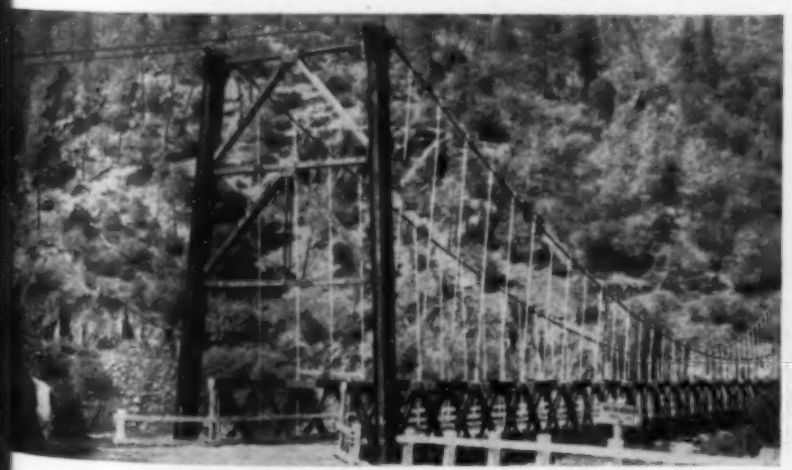


ROCKERS AT BASE OF SHAFTS PROVIDED BOTH LATERAL AND LONGITUDINAL ROTATION OF THE SHAFTS

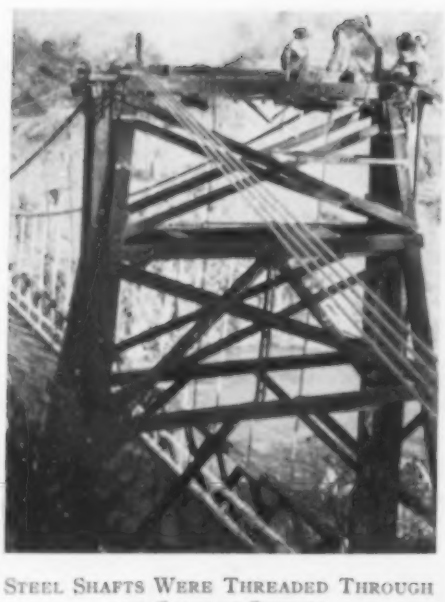
Each tower shaft, 41 ft 3 in. in length, was composed of a built-up riveted H-section of two 12-in. wide-flange 28-lb beams and one 21-in. wide-flange 59-lb beam, connected by two panels of K-frame bracing made up of 12-in. I-beams.

The head end was saw-cut to a true plane, and to it were attached two plates, 1 in. thick, fitted with guide and stop angles, to receive the existing steel saddles. The foot end was also saw-cut to a true plane, and to it the plates comprising the upper rocker unit were attached by fillet welding. Bearing was distributed to these plates through 12-in. I-beam stiffeners. These plates in turn rested on a middle rocker placed at right angles to the upper unit. The bottom bearing plate was welded to a 12-in. 31.8-lb I-beam imbedded in the concrete footing block, as shown in an accompanying photograph. This rocker allowed both lateral and longitudinal rotation of the tower legs.

The top rocker permits longitudinal rotation of the shaft, which was required to plumb the columns and to compensate the



NEW STEEL TOWER IN PLACE



STEEL SHAFTS WERE THREADED THROUGH AND SADDLES SHIFTED

cable stresses due to the passage of live loads over the structure. The middle rocker permitted lateral movement of the shafts during erection. After the tower legs were in place and the bracing riveted up, shims were placed permanently under the middle rocker and grouted in. This locked the middle rocker unit, leaving the top rocker free.

Two 50-ton jacks mounted at the top of the timber A-frame were used to shove the saddles onto the head plates of the steel tower legs. Some resistance was met in overcoming friction between the saddles and the end grain of the wood in the posts. There was also the horizontal component of the cable stress to contend with. The cables cradled from 14 ft center to center at mid-span to 18 ft at the saddles. This distance was increased several feet during the jacking operation, increasing the horizontal thrust against the jacks. As a safety precaution, wire-rope guys of $^3/_4$-in. diameter, with turnbuckles for slacking off, were kept attached to the tops of the steel tower legs during the jacking operations.

While jacks held the heads of the shafts separated, the upper half of the timber frame was removed. The shafts were then rocked into place and the K-frame bracing was erected and riveted in place. The rest of the timber was then removed.

The original rockers under the saddle castings were permanently sulfured in place so that they could no longer function. This confined the longitudinal movement of the new towers to a rotation about the rocker on their bases.

The contract was completed in 64 working days by the Kiss Crane Company of El Cerrito, Calif. Actual jacking operations required $7^1/_2$ days. Bridge traffic proceeded without interruption during the entire construction period.

Intermittent Sand Filter Found Useful in Rural Sanitation

By PAUL M. HOLMES, M. AM. SOC. C.E.
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WHEN the current war emergency involved the United States, it became apparent that immediate and major changes in industry and living conditions were inevitable. Huge plant programs and shifting populations required speedy consideration of sewage disposal problems. Shortages of manpower and essential materials further complicated the picture, and yet in spite of difficulties some means had to be devised quickly to meet the situation. Simple devices and non-essential materials were mandatory. Load demands varied from a few persons to many thousands. Speed of construction was the keynote.

In Ohio as in many other states, stream pollution had already reached a high point. The immediate problem concerned measures to prevent any increase in the existing pollution load. Wherever possible, fundamental sanitation measures were applied. In certain camps, small or seasonal industries, and in certain housing developments, individual sewage treatment devices were constructed. Early experience indicated, however, that restricted areas were not adaptable to this form of sewage disposal.

For many years, rural schools and other places of minor congestion have been cared for satisfactorily by primary sedimentation and secondary treatment, usually by intermittent sand filtration. Sand beds in use were dosed or loaded theoretically to a depth of 3 in. by a dosing device and through a single outlet located in the center of the bed. After considerable study it was decided that the existing devices had an overall efficiency of approximately 60%. It was also believed that 100% efficiency could be attained if an improved method of loading the bed were used. Rotary distribution for trickling filters provided a solution to the problem.

The complete plant then consisted of a rectangular settling tank with a detention period of eight hours, a dosing chamber equipped with dosing siphons or pumps, and the intermittent circular sand bed of conventional design equipped with a gravity-type rotary distributor (Fig. 1). Such a plant met the requirements of simple construction, a minimum of non-essential materials, low cost, and adequate treatment.

The average five-day B.O.D. at 20 C was accepted as 180 ppm for the sewage considered. The old-type filter was loaded on this basis volumetrically at 100,000 gal per acre per day. With the increased efficiency in mind

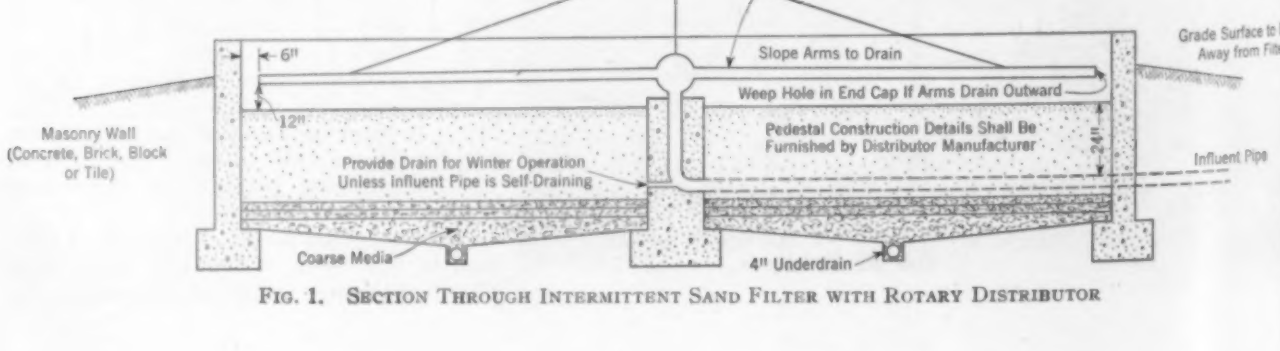
Rotary Distributor
6"
Slope Arms to Drain
Grade Surface to Drain Away from Filter
Weep Hole in End Cap If Arms Drain Outward
12"
Pedestal Construction Details Shall Be Furnished by Distributor Manufacturer
24"
Masonry Wall (Concrete, Brick, Block or Tile)
Provide Drain for Winter Operation Unless Influent Pipe is Self-Draining
Influent Pipe
Coarse Media
4" Underdrain

FIG. 1. SECTION THROUGH INTERMITTENT SAND FILTER WITH ROTARY DISTRIBUTOR

he rotary-type filter was assumed capable of operating atisfactorily under a daily load of 200,000 gal per acre. his had the effect of reducing the originally required and area to 50% and was an important economic ctor.

The filter shell was constructed of wood, masonry, or arth embankment and its only function was to contain he filter media and to protect the top from surface ash. The floor of the filter was unpaved and was loped to 4-in. field-tile underdrains located on 10-ft enters. Coarse media was placed to a depth of 12 in., nd 30 in. of approved filter sand was required, as shown the accompanying Fig. 1. Original sand specifications equired a grain size of 0.30 to 0.45 mm, but this was

TABLE I. TREATMENT PROVIDED BY FIVE TYPICAL PLANTS

SEWAGE CHARACTERISTICS	No. 1	No. 2	No. 3	No. 4	No. 5
Settleable solids:					
Applied	2.0	8	4	5	3.0
Final	T	O	T	O	T.
pH:					
Applied	5.6	5.7	7.6	6.0	6.1
Final	5.6	5.9	7.4	5.9	6.0
D.O.:					
Applied	0.0	0.0	1.9	0.0	0.0
Final	7.9	2.8	8.1	6.5	7.5
B.O.D.:					
Applied	425	666	319	555	326
Final	6.7	26	4	18	2
B.O.D. reduction, %	98.43	96.3	99.1	96.8	99.0

evised to 0.35 to 0.50 mm when difficulty was experienced with some sands which were approved at 0.30 mm. nvestigation of flooding tendencies disclosed that the and applied to the filters had an actual effective size of 0.18 to 0.22 mm.

The filters which produced the best results were equipped with sand having an effective size of 0.45 mm and a uniformity coefficient of approximately 2.75. The results of laboratory analyses have been compiled for five plants and are shown in Table I.

In cases where suspended solids ran high, more labor was required to maintain the high efficiency of the filters. If excessive deposits occurred on the surface of the sand, a hard scum formed which called for bimonthly removal. Under ordinary conditions, however, a minimum of attention was required to prevent pooling. Occasional hand raking served to keep the filters in prime working condition.

Most of the early installations were provided with dosing chambers equipped with 5-in. automatic siphons. Later designs, however, provided an ordinary wet well equipped with dual pumps, even where grades would permit gravity control. Small pumps were available and an economy was effected by such construction. It is now recommended that pumps be installed in all new plants where power is available, as better operation has resulted from power loading of the beds. In many instances rotary filters have been loaded far beyond their rated capacity without visual nuisance conditions resulting.

Many of the previously described sewage-treatment plants have been in operation during the war period and have produced excellent results. Nuisance conditions have been held to a minimum and water supplies have been protected. Sufficient data are available to indicate that the rotary-type sand filter has a place in rural sanitation.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Over-Design of Sanitary Works Not Justified

DEAR SIR: With respect to the report of the Society's Committee on Evaluation of Professional Objectives in Design of Sanitary Engineering Works, in the March issue, our organization is not so much concerned with patented processes and equipment as it is with the discredit that is frequently cast upon the engineering profession by unjustifiable over-design of sanitary works.

Such over-design is often responsible for: (1) More elaborate sewage and trade-waste treatment than is called for if the volume of flow and characteristics of the outlet stream are properly investigated and correctly evaluated; and (2) over-sized plant or portions of plant because of excessive provision for volume of flow or strength of flow far beyond present conditions.

Conscientious engineering would seem to dictate emphasis on skillful planning for expansion when needed, rather than on excessive present construction cost. The latter course, which is often followed, unnecessarily increases engineering fees or expenditures for engineering, and usually results in an expensive service to the client or owner not anticipated initially.

A cut-rate engineering fee can prove most uneconomical if it ultimately results in excessive construction cost. Excessive construction cost can also result from excessively large buildings for housing equipment, unwarranted and expensive architectural treatment, excessive equipment installations, and the like. All such excesses should prove disturbing to a good engineering conscience.

Reasonable provision for future increase in flow is certainly desirable. However, when a city's growth in population has been slight for the past 20 years and there is no particular reason to anticipate early rapid growth, it is hard to justify a plant capacity double present needs or more.

We believe firmly in inventor's reward. We have no objection to condoning or even encouraging the use of patented processes and equipment, if the selling price includes a fair price for labor and materials, selling costs, and other overhead and a reasonable profit, plus reasonable compensation for the inventor or patent holder, provided that final cost is commensurate with the benefits involved. Processes or equipment that are sold infrequently rate higher profits and royalties than do those which enjoy wider marketing.

However, holders of patents should realize that they are speeding the day when their royalties and monoplies will be destroyed, if excessive royalties are claimed and competition on important processes and equipment is virtually absent. Such manufacturers and inventors have greater responsibility in the matter of patented methods and articles than does the designing engineer.

Where a particular process or piece of equipment has a desirable end result which cannot economically be obtained by other suitable means, the designing engineer can hardly be criticized for specifying it. Where there are alternative equivalent processes or equipment items, the designing engineer should most certainly obtain competition for his client. In many cases evaluation clauses should be introduced into the specifications, and there should be proposal forms for the proper grading of alternative processes and items of equipment. In other words, if the seller of a rubber-tired wheelbarrow wants more than 150% of what we can buy an ordinary wheelbarrow for, we shall buy the ordinary one.

The proper conception and phrasing of an evaluation clause in the case of patented processes and equipment is a task to challenge the ingenuity and judgment of the engineer. Both investment and operating costs, as well as operating results, must be considered in forming such clauses. Where an engineer in private practice

FIG. 1. SECTION THROUGH INTERMITTENT SAND FILTER WITH ROTARY DISTRIBUTOR

feels the urge to develop alternative bidding involving patented processes and/or equipment, he should seek additional compensation from the client, rather than leave it to one of the competing manufacturers to develop alternative plans at his expense before he can bid. True competitive bidding cannot result unless the alternative plans and specifications are the responsibility of the engineer. Plans and specifications prepared by a bidder must necessarily be evaluated for suitability of design.

A well-developed practical sense of what is right and what is wrong is probably the engineer's best guide as to what to do in matters involving patented processes and equipment. Only a professional coward fearful of criticism will shrink from specifying suitable economical patented ways and means with proper safeguards. Many projects, too, have suffered because of an engineer's unwillingness to specify a good patented process or piece of equipment until it has come into general use.

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Bargaining Agency for Professional Workers

TO THE EDITOR: A letter to the editor by T. F. Doll, in the June 1944 issue, announced the certification of the Research and Engineering Professional Employees Association (R.E.P.E.A.) as bargaining agent for nearly all of the non-supervisory technical personnel at the Whiting (Ind.) Refinery of the Standard Oil Company. Readers of CIVIL ENGINEERING may be equally interested in the fact that the R.E.P.E.A., of Whiting, Ind., and the Standard Oil Company (Indiana) signed a contract on March 12, 1945. The R.E.P.E.A. was formed July 2, 1943, and was certified by the National Labor Relations Board on February 29, 1944. About 90% of the engineers and chemists in the bargaining unit are members of the organization.

The R.E.P.E.A. was the first independent organization, composed solely of technical employees at the professional level, to obtain NLRB certification. A second such organization—the Association of Professional Engineering Personnel, at RCA Victor in Camden, N.J.—has recently been certified, and the Association of Industrial Scientists, at Shell in Emeryville, Calif., has petitioned the NLRB for certification.

The chief feature of the contract, which will be effective until March 31, 1946, is a well-defined procedure for handling questions involving salaries, hours, and other conditions of employment. This procedure culminates, if necessary, in arbitration by the U.S. Department of Labor. A friendly relationship exists between the Company and the R.E.P.E.A.; the contract is evidence that this relationship will continue. Since collective bargaining for technical employees at the professional level is a new development, both the company and the R.E.P.E.A. devoted much time and study to the preparation of this contract.

During the year since certification, numerous other matters, in addition to the contract, have been the subject of discussions between Association and Company representatives. Agreements reached on several of these matters have been incorporated in the contract. One such item is a provision to encourage attendance at national meetings or committee meetings of recognized technical and professional societies. The Company will grant leaves of absence with pay to each technical employee for a period up to six days per year for attendance at such meetings.

PHILIP HILL
Chairman, R.E.P.E.A.
Public Relations Committee
Whiting, Ind.

Postwar Planning and Financing of Engineering Works

TO THE EDITOR: The article by Hal H. Hale on postwar highway construction programs, in the April issue, is interesting, but it assumes that the engineer in his demands for public works is above the demands of private enterprise. It assumes that public funds, public indebtedness, to the extent of many billions of dollars, will be available to pay for these highway programs. It also assumes that other billions will, at the same time, be available to pay for river conservation, power developments, and so on. In short, in addition to our tremendous existing indebtedness, there is no limit to our borrowing capacity.

Mr. Hale also makes the following assumptions:

1. That there will be a postwar demand for jobs, work on highways, and so on.
2. That highways, or their expansion, are an indispensable feature in the postwar economic development of the United States.
3. That, after the war, there will be a demand not only for the continuation of the prewar programs of highway construction, but also for the made-work programs of the thirties.
4. That the money for this work will come from public funds.

Incidentally, while we are doing all this, we shall have to rehabilitate the rest of the war-torn world, and rehabilitate our own disrupted commercial enterprises.

This program entirely ignores the question of transportation economics as a whole in the United States and the vital rôle the railways have played in the war effort, the part they must play in reconversion to postwar commercial economy, and the fact that without railways we could not have begun to meet the transportation problems of the war. The programs for public works ignore the fact that they will be in direct competition with private enterprise both for labor and for capital.

The argument for the use of public funds ignores the demand for capital for the rehabilitation of private commercial industry on which our whole prosperity is founded. Unless we have successfully rehabilitated private industry there will be no public funds. We cannot depend on patriotism to buy bonds for private industry at low rates of interest, or even at high rates, unless there is a belief that our country will continue to be prosperous.

The railways, while subject to strict regulation, both federal and state, depend on private capital. They need rehabilitation, repair and renovation of roadbed, track, and rolling stock to make up for the deferred maintenance to which the shortages of labor during the war and the demand for war matériel have subjected them. This will be true in spite of declining revenues.

Telephones and other means of communication have not only deferred maintenance but also serious shortages of plant to make up. For instance, the American Telephone & Telegraph Company also has indicated its need for $5,000,000,000 additional capital for postwar extension to meet present foreseeable demands. This has to be private capital. This is true in some degree of almost every line of commercial endeavor.

So far our commercial prosperity as a nation has depended on this flow of private capital to commercial enterprise, but if we are to look forward after the war to an increase of billions of dollars of public debt for highways, waterways, river control, and so on and to meet the demands of our already tremendous public debt, where is the private capital to come from?

Some people—among others Bernard Baruch—seem to think that if private industry can obtain capital, it will furnish all the jobs required by men from our disbanded armed forces as they return to civilian life. Surely we, as engineers, should prefer this to made work and expenditure of public funds.

FRED LAVIS, M. Am. Soc. C.E.
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Comments on E.C.P.D. Reading List for Junior Engineers

TO THE EDITOR: I have always assumed that the Engineers Council for Professional Development preserved a judicial attitude on economic and political questions, but after looking over the "Reading List for Junior Engineers"—published in the April issue—it seems to me the scales have been tilted toward the radical side. For example, I find Karl Marx in the list, but not only is Adam Smith omitted, but he is alluded to, in a note on Thoreau's *Walden*, as follows: "This is a handbook of an economy that endeavors to refute Adam Smith and transform the round of daily life into something nobler than a mean gospel of plus and minus."

Also, under Karl Marx's *Capital* is the note: "A critique of political economy. Written originally to make plain the fallacy

italistic economy and still held to be the source from which anti-italistic movements draw their constructive power."

Would it not have been more judicial to give the junior engineer opportunity to read the *Wealth of Nations* so he could determine himself whether Adam Smith was really "refuted" by Thoreau, whether Marx really made plain "the fallacy of capitalistic nomy."

lso, I find works by such liberals as Thorstein B. Veblen, Lin- Steffens, Stuart Chase, Harold J. Laski, and G. D. H. Cole, no books by comparable conservatives who, it seems to me, uld have been represented.

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Universal Change to Metric and Decimal Systems Advocated

TO THE EDITOR: I have read with much interest Arthur N. lberg's letter, entitled "Change to Metric System Advisable," the "Our Readers Say" department of the May issue, and fully ee with him that the British system of weights and measures is cumbersome and confusing, and that sooner or later this change st take place.

Recently I submitted to the United States Commissioners at the Francisco Conference four propositions for the consideration the group. Two of these propositions are as follows:

That the cumbersome British system of weights and measures abandoned for the simpler and easier metric system.

That, for the same reason, all the countries of the world opt the United States decimal system of coinage, based upon e international standard.

t seems to me that both these suggestions are reasonable and results are to be desired.

THEODORE BELZNER, Affiliate Am. Soc. C.E.

klyn, N.Y.

Periodicity in Variations of Lake Level

TO THE EDITOR: I was much interested in Mr. Woolley's de-ption of the Great Salt Lake, in the August 1944 issue, and ticularly his references to the variations of lake level over the t 90-odd years since observations have been made. In explain-the changes in level, Mr. Woolley rather summarily dismisses theory of "changing climate" as being inadequate to account the rise of the lake level between 1905 and 1924, yet the fluctua-ns of level are ascribed to a balance of two variable factors—cipitation and evaporation—which in themselves must derive r variability from seasonal and secular changes in the weather. here is a large body of opinion that holds that most of the eorological and climatological phenomena of this earth are licable in terms of component periodicities, whose physical sig-cance is real though not always readily apparent. It cannot be said that any particular success has attended the efforts of estigators to unravel these periodicities, but it has to be admitted t the problem is one of extreme complexity and offers many pit-ls for the unwary. Nevertheless, there now seems to be indubit-e evidence in one form or another that periodicities exist in most tural phenomena, and the influence of cycles has been read into secular variations of annual precipitation, temperature and ssure, solar activity, growth of vegetation, flow of rivers, levels kes, wheat prices, volcanic eruptions, and so forth.

have recently become interested in this general question ough being confronted with the problem of isolating the wave nponents of small tidal oscillations, and have been encouraged pply the methods of analysis to data outside the original sphere my investigation. Even cursory examination of the data given Fig. 2 of Mr. Woolley's article suggests that cycles of change are erent in the variations of the Great Salt Lake levels. Although man influences are bound to have asserted themselves, it is dly likely that they will have obscured the natural effects of odic change, assuming these to exist. The data should therefore reveal the existence of periodicities if they are real, even though the amplitudes of the component terms may be radically altered by such indeterminate factors as irrigation and draw-off.

A rough analysis by the Method of Residuation (Sir Napier Shaw: Manual of Meteorology, Cambridge, 1928, Vol. 1) suggests the existence of periodicities of 6.6, 11, 21, 32, 66, and 92 years besides the ordinary annual variation which is quite definite. I make no claim to have conducted this analysis with any great thoroughness and therefore submit the results as approximate indications only of a preliminary identification. On the significance of the results, moreover, I retain an open mind but the suggestion of periodicities is nevertheless strong. A periodicity of 92 years might possibly be evidence of the fourth harmonic of the lunar-solar cycle of 744 years (Shaw: Manual of Meteorology, Vol. II, p. 319), and the smaller periodicities could also, no doubt, find a place in the scale of higher harmonics. The 11 and 21-year periodicities are close to the 11.5 and 23-year cycles found by Abbot (*Solar Radiation and Weather Studies*, Smithsonian Misc. Collections, No. 10, Vol. 94, 1936) and are therefore to be ascribed more particularly to solar activity.

Assuming these periodicities to be real, it is almost certain that in the next 30 years the level of the Great Salt Lake will rise considerably above what it has been in the last decade. This may be inferred from the coincidence of levels in recent times with the trough of the main 92-year periodicity. It will be interesting to see, with the passage of years, whether the lake level does indeed rise to new crests or continue to shrink to an ever diminishing depth.

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Forum on Professional Relations

CONDUCTED COLUMN OF HYPOTHETICAL QUESTIONS WITH ANSWERS BY DR. MEAD

After a two-month vacation Dr. Mead resumes, in the current issue, his column on engineering ethics. Herewith he gives his answer to Question No. 31, which was announced in the February number and originally scheduled for publication in the April issue. The question reads as follows: "A young man is in the employ of an engineering concern, which is supervising the work being done by an honest and reliable firm of contractors. The contractors, having had an opportunity to observe the young man on the job and to see that he is very capable, offer him a position in their organization at the same salary he is getting from the engineering concern. If the young man feels that he is bettering himself and gives his employer sufficient notice, is he justified in taking the new position while the engineering firm and the contractor still have business relations with each other?"

The writer would feel that he would not care to place himself in a position where he would have personal relations with both the engineering firm and the contractor when they were still continuing business relations with each other. Thus the acceptance of such a position would likely lead to embarrassments. In the writer's opinion, therefore, it would be impossible for the young man to accept and to serve under the conditions described in the question.

However if, upon accepting, the young man were to be placed on work in which his previous employer was not interested, the writer would then feel that the possibility of such an embarrassing situation would not arise. Should the contractor himself contact the engineering firm and ask if it were agreeable to them for him to offer the young engineer a position, this would also alter the case.

Question No. 32, which was announced in the March number, will be answered in the forthcoming, or July, issue. Next in the series, the following question is announced. Replies may be received until July 5, with answers in the August number.

QUESTION NO. 33: *A young engineer working for a large manufacturing company has an opportunity to do some work outside his regular hours with the company. The work is not technical and is in no way connected with the company. Is the engineer justified in employing his spare time on such work?*

SOCIETY AFFAIRS

Official and Semi-Official

Board Names William N. Carey Secretary

THE BOARD of Direction has appointed William N. Carey, M. Am. Soc. C.E., to succeed George T. Seabury as Secretary of the Society. Colonel Carey, a consulting engineer of St. Paul, Minn., has more recently been serving as Chief Engineer of the Federal Works Agency, with offices in Washington. The Board's action was taken at its Chicago meeting April 16 and 17, with the provision that it was to be effective upon the Colonel's release from active duty with the Army.

WILLIAM N. CAREY, Secretary

Intensely interested in Society activities, Colonel Carey has served on many working committees, most recent being the Committee on Employment Conditions. He also served as the Society's representative on the Highway Research Board. He was a member, then chairman (1940) of the Highway Division Executive Committee. For several years he has been chairman of the Division's Committee on Military Road Construction and Maintenance. Embodying this committee's work, Manual 23 was published by the Society in 1941 summarizing latest data on construction and maintenance of "Military Roads in Forward Areas."

Elected to the Board of Direction in 1941, he represented District 7 for three years. During this term he served on the committees on Professional Conduct and on Division Activities. He has been a member of the Society since 1916.

FROM THE MIDWEST

A midwesterner by birth, Colonel Carey has spent a large part of his professional career in public works in and around St. Paul. After graduation from the University of Minnesota, he worked for several years with the War Department on hydrographic surveys, and the design and construction of storage dams and channel structures. This work was interrupted by World War I, in which he served first as Captain then as Major in the Corps of Engineers, commanding the 1st Battalion of the 313th Engineers. Later, as Assistant Corps Engineer, 7th Corps, he was in charge of the rehabilitation of about 300 miles of German roads in the Army of Occupation.

For several years after the war he served with a firm of consultants in St. Paul. Subsequently he became Assistant Engineer, then City Engineer of St. Paul. In this post he was responsible for the design and construction of roads, sewers, bridges, airport facilities, and other engineering structures. During the ten years he served the city, St. Paul completed an extensive civic improvement program.

IN PUBLIC WORKS AND PRIVATE PRACTICE

When the Public Works Administration began functioning in 1933, Mr. Carey was picked as State Engineer for Minnesota later supervising the $17,000,000 sewage treatment project undertaken by the Minneapolis–St. Paul Sanitary District with PWA funds. Following completion of this work he opened an office in St. Paul, engaging in consultation for municipalities on roads and sanitary engineering works and for industrial firms on highway, sewer, and dam construction. He was a member of the engineering board in charge of the review of design and construction of the two-million-dollar Duluth, Minn., sewerage project.

Holding a commission in the Army Officers Reserve, Carey was ordered back into active service in April 1941. For a year he was in charge of the design of Army airdromes and camps in Jacksonville, Fla. In 1942 he was transferred to Washington, D.C., and assigned as Chief Engineer of the Federal Works Agency under Maj. Gen. Philip B. Fleming.

Colonel Carey has written numerous papers on roads and pavements, most recently on military roads. Also he has invented several useful construction devices, including a batch interlock for paving plants and a rolling lock gate-operating machine. Turning his attention to airport needs, he devised a ceiling indicator which has seen considerable use.

The new Secretary holds membership in numerous organizations in addition to the Society. Among these are the Minnesota Federation of Engineering and Architectural Societies, of which he is a past president; Minnesota Association of Professional Engineers; St. Paul Engineers' Society; the Society of American Military Engineers; Reserve Officers Association, U.S.; the Central States Sewage Works Association; and the American Road Builders Association. He is a licensed professional engineer in Minnesota.

The appointment of the Secretary is a yearly event, as provided by the Society's By-Laws. The appointment (usually a reappointment) is made at the second meeting held after the Annual Meeting. The majority vote of the Board is required to appoint or terminate service. This appointment as executive officer of the Society carries an initial salary of $12,000.

Major General Fleming, Colonel Carey's superior, in commenting upon the Colonel's appointment as Secretary said, "The loss of Colonel Carey's services to this Agency will be regretted. However, I feel that as Secretary of the American Society of Civil Engineers, he will be able to make a more important contribution to national problems and particularly to those of the reconversion period."

Junior Emblems Again Available

THE MANUFACTURER of the Society's membership emblems reports that sufficient metals and materials are now available to resume the production of Junior badges. Since March 1, 1942, there has been no production of these Junior emblems, owing to Government priorities, scarcity of metals and materials, and the manpower shortage. The badge for Juniors is of blue and white enamel and is mounted as an ordinary pin with safety catch. It sells at $2.00 and any Junior who has not previously received a pin may send in his order at once. A remittance covering the order will help eliminate bookkeeping overhead.

Fortunately, an ample supply of badges for Corporate Members has been available during the war and the sale of these emblems was not interrupted.

Secretary Seabury Called from Life's Responsibilities

When a man lives as intensely as George Seabury did, it is ult for him to recognize the necessity for just taking things Also it is difficult for others to realize that such a man will work on without ever slowing up. Perhaps that is one reason it is difficult to learn that he won't be at his big desk today y day from now on. George T. Seabury died Friday morning, 25, 1945.

e was not long ill. In fact, on Tuesday, May 22, he went ugh his usual day at the office. As always he took no time to k about himself during the day but when evening came he was even more tired than usual as he went home to his apartment Manhattan's Washington Square. In the night he suffered a t attack and on Wednesday he was taken to the hospital, re he seemed to rally. For two brief days his unfailing spirit the struggle, but on Friday, May 25, he could hold out no er and he slipped quietly into the rest he would not take in life.

r. Seabury's separation from Society work came at a juncture ch he had planned for some time. Although he lived only for work with the Society, he knew that someone else should be ming the burdens of administration. In a letter to the Board Direction in January he said: "I have given all that it was in to give .... It is an ardous job and I have thoroughly enjoyed but ... I should give none other than my best years to it." s with characteristic concern for his Society, George Seabury ed that he be relieved of the task he had performed so capably over twenty years.

a compromise on his request for retirement, the new Board 5) persuaded him to accept appointment as Assistant to the sident, a new post, on a part-time, part-pay arrangement. s action, which was taken in Chicago on April 16 and 17, was to e become effective on June 1, when the new Secretary, William Carey, could assume office. The Board's action in Chicago's ner House reminded several "old timers" of that special meet- in the William Penn Hotel in Pittsburgh, on the first of Decem- 1924, when Mr. Seabury was first appointed Secretary.

Succeeded John Dunlap

The office of Secretary had become vacant when John H. Dun- , the preceding Secretary, was killed as the result of a tragic train k while returning from a convention of the Society at Pasa- a. Seabury was sponsored for the office by Frank E. Winsor Thaddeus Merriman, both at that time members of the Board Direction. He had worked many years with both of these neers, on the Catskill water supply for the City of New York. er he had worked with Mr. Winsor on the water supply for vidence, R.I.

Long before he came to Headquarters on New Year's Day 1925, had demonstrated special interest in the activities of the Society. mediately after graduation from M.I.T. in 1902 he applied for mission as a Junior, was accepted and then trained his sights Associate Member grade. As soon as his experience warranted move, he applied for transfer and was again successful. It s but a few years until he became a Member.

n New York and later in Providence, where he was division engi- r on the eighteen-million-dollar water supply project, he took much time as he could spare for his work with the Society. It med as though the best chance for development was through ociation with other engineers in the Society. Therefore few of acquaintances were surprised when he was chosen as Secretary— of all the possible Society appointees.

rom that point on George Seabury and the Society have been ed together indistinguishably. Long hours at his desk at adquarters supplemented by many night hours at his home, d frequent trips to Local Sections in every part of the country, e provided him with a knowledge in minute detail of the vast ount of Society business, and a wide acquaintance with its mbers. No matter has been too unimportant or too complex his attention. Each item received his meticulous consideration.

Professional Development a Goal

Ever mindful of his own early career, George Seabury, for whole of his 20 years and 5 months with the Society, strove develop the professional status of engineers. Early he gave approval to the registration of engineers and sponsored the drafting and redrafting of the "Model Law." This was recommended by the Board of Direction in 1925 for adoption in states "where registration should be desirable." More recently he urged the accrediting by the State Registration Boards of "Engineers-in-Training." Help for young engineers in their professional careers has been exhibited too in his interest in the establishment of the Engineers' Council for Professional Development.

Other activities of not dissimilar nature have included resistance to the calling for competitive bids for engineering services; expansion of the employment service operated jointly by the Founder

The Late George T. Seabury, Secretary of the Society

Societies; study and upgrading of engineering fees, salaries, and employment conditions.

Most fertile field for such work was offered in the depression years of the early thirties. Realizing that inevitably money was going to be spent on made-work programs, it was deemed proper to make provisions that only works of lasting benefit would be constructed. Practically commuting between New York and Washington, Secretary Seabury brought the attention of government officials to the Society's interest in the development of only economically sound and worthwhile projects.

Subsequently on federal public works, thousands of engineers were employed in the development of plans and in supervision of construction. Federal extension of the triangulation and level systems of the country absorbed large numbers of engineers during that depression period. Another active enterprise was the Public Works Agency, which was manned by engineers many of whom were recommended by Secretary Seabury at the request of the first head of PWA, Col. Henry M. Waite, who was later to become an Honorary Member of the Society.

Membership Growth

When Mr. Seabury stepped into his new post with the Society, membership stood at a little over eleven thousand. It was clear that only through inclusion of a maximum possible number of qualified engineers in Society membership could the best interests of the profession be served. His continuous efforts toward this end are reflected in the growth to nearly twenty-one thousand at the time of his death.

Largely responsible for this growth was the stimulation of Student Chapters and the encouragement of students to join as Juniors immediately upon graduation from college. An action early in 1925 was the suggestion of a reduction in the number of corporate member signatures required on applications for

Junior membership, and adjustment of the credit for scholastic work. An immediate rise in the number of applications resulted.

As membership grew, the financial stability of the Society also increased under the Secretary's management. In 1925 current operations were being curtailed by the payment of interest on a $200,000 mortgage on the 57th Street property in New York City, which had formerly been Headquarters. Through skillful dealing, arrangements were made which wiped out this indebtedness and made the property income producing on a materially increased scale. Today the income from this property and other sources exceeds $500,000 a year.

PUBLICATIONS A SERVICE

For some time Seabury was stumped by the problem of making the publications of the Society more fully representative of the interests of all members of the Society. Most of the papers published were highly technical in nature. Mr. Seabury reasoned that large numbers of the membership earned their living without the necessity of knowing intimately the values of intricate formulas.

These men needed a "how" and a "why" publication, and there was but one way to provide it—establish a new type of periodical with more popular and timely reports of works in progress, stressing the unusual features of such work. The result was CIVIL ENGINEERING, issued first in 1930. At once it became a popular Society organ.

Throughout his years of association with the Society, Mr. Seabury maintained the relationship of servant to the Board and its committees. As a matter of fact, he was insistent that in all cases other members of the staff maintain the same relationship. His accomplishments have taken place through quiet, persuasive, thoroughly substantiated suggestions to those who made policy. Opinions expressed in answer to inquiries often resulted from months, sometimes years, of study that had been made with the foresight that some day the topic would be ready for adoption.

It was at meetings of the Society throughout the United States that Mr. Seabury became most widely acquainted with thousands of the Society's members. Mrs. Seabury often accompanied her husband on these trips, and her gracious manner stimulated spontaneous friendship wherever she went. In her grief she is supported by the sympathy of these many friends. Yet it is hard for her and for those who knew him well to help regretting that life did not permit George Seabury to develop those interests outside the Society which he had planned upon retirement.

The funeral was held at the Church of the Ascension in New York, N.Y., on Monday morning, May 27. A large throng of Society and staff members, also former officers, attended to show their deep affection and respect for the Secretary. Interment was later in the day at Swan Point Cemetery, Providence, R.I.

Valued Addition to Society Files

MEMBERS will doubtless recall with pleasure the series of five articles entitled "Engineers' Odyssey to Europe—1889," which appeared in CIVIL ENGINEERING from January through May of this year. These reminiscences of the four surviving Society members who took this notable trip still hold interest—they recall the days of the "Grand Tour" which now seem very far away, especially in the light of recent events. Members will doubtless be glad to know that the complete accounts prepared by the four narrators, and their original source material, have been placed in the permanent files of the Society, where they are available to interested researchers.

Also of interest in connection with this series is the fact that the Board of Direction took a special vote of thanks and commendation, passed unanimously, in part as follows:

"The Board of Direction takes this opportunity to acknowledge the work of four of its older members in contributing valuable material to the Society's archives. Those who have thus served the Society are:

Andrew J. Provost, Jr. (who acted as sponsor), A. Prescott Folwell, James B. French, and T. Kennard Thomson.

"The Board hereby unanimously commends these four members for this service. It instructs that the records be preserved for the benefit of future Society use. It also takes this means of formally thanking them for this labor of love, insuring a proper history of events that they only, of all Society members, are now privileged to remember."

Public Works–Construction Industry Advisory Committee Organized

AT THE organization meeting of the newly formed Public Works Construction Industry Advisory Committee, E. L. Chandler, Society's Washington Representative, was named chairman. The session was held on April 26 in the Federal Works Building, Washington, D.C., and F. Stuart Fitzpatrick, representing the U.S. Chamber of Conference, was selected to be Secretary of the Committee. Col. William N. Carey, M. Am. Soc. C.E., Chief Engineer of the Federal Works Agency, was designated by the Federal Works Administration as the contact between the Committee and the Administrator.

Formation of the Advisory Committee was in response to a need for closer contact between the Administrator of the Federal Works Agency and national organizations concerned with both public and private construction. Major General Philip B. Fleming, Hon. Am. Soc. C.E., the Administrator, stated the purpose to be "to advise me as Administrator, Federal Works Agency, of the views of the Committee relating to matters of mutual interest." The Committee will be subject to call on short notice to consider specific proposed actions of the Agency. The Committee is genuinely independent and will express views of the various organizations represented.

Membership on the Committee when formed was held by eleven national organizations. They are:

American Association of State Highway Officials
American Institute of Architects
American Municipal Association
American Public Works Association
American Society of Civil Engineers
American Society of Mechanical Engineers
Associated General Contractors of America
Building Trades Council, A.F. of L.
Producers Council
United States Chamber of Commerce
United States Conference of Mayors

Although membership in the Committee as formed was upon invitation of the Works Administration, it is not intended to be restricted, and other national organizations can be added through Committee recommendations.

Mr. Chandler was appointed the Society's representative on the Committee by the Board of Direction at its Chicago meeting.

Recommendations to Expand Construction Offered

APPEARING before the Senate Small Business Committee on May 10, 1945, Malcolm Pirnie, Past-President of the Society, stated that planning in advance for both public and private construction activity during the next few years has not been carried on in a manner which will encourage rapid expansion of building operations.

In order to remedy this situation, Mr. Pirnie recommended the immediate adoption of a six-point program by the federal government, as follows:

1. Allow the cost of making private construction plans to be considered as current operating charges, exempt from federal income taxation.

2. Beginning immediately, gradually lift the limit of construction work coming under the War Production Board's L-41 Order. The limit now applying is $200. By raising this figure as rapidly as is found compatible with the military situation, the WPB will provide a powerful incentive for materials and equipment dealers to stock up, and will encourage the establishment of new dealerships to replace those closed during the war.

3. If possible, an immediate general tax reduction. If this is not possible then provide an incentive for risk capital to enter the construction field by exemption from surtax of income invested in construction. This should apply all along the line, even to the individual who makes a down payment on a home.

4. Through the WPB, make tools and materials available for the manufacture of construction equipment for contractors.

5. Increase the 17½ million dollars recently appropriated to make available loans to state and local governments for public

ks planning which is to be administered by the Federal Works ency.

Establish a statistical survey of construction plan preparation actual construction volume, on a full-time basis. The Federal rks Agency is the logical place for the public works phase of this tistical survey. The suggestion has been made that the Bureau Foreign and Domestic Commerce establish an overall construc- division to correlate all construction data, and this idea appears ave much merit.

Mr. Pirnie also expressed the belief that there are serious dangers the too extensive use of public works for stabilization of the con- ction industry. He indicated that there are other means ich can be used to stabilize the activities of the industry which not as dangerous as the extensive use of public projects.

The controls he offered are adjustment of incentive features in Revenue laws of the country, and changes in the interest rates federally insured construction loans. Public construction should stabilized through the activities of the Federal Works Agency, ording to Mr. Pirnie, but the two phases of construction opera- ns should be coordinated.

Progress on 1944 "Transactions"

MEMBERS have been advised of the delay in printing the RANSACTIONS due last fall, as explained previously in the January d February numbers of CIVIL ENGINEERING. Since there ems to be continued doubt in the minds of some members, this te is for the purpose of reiterating the reasons for the delay, ich now affects only the leather-bound and cloth-bound copies. Basically it was inability to obtain the supply of printing paper which the Society was entitled. Due in the late spring of 1944, is paper did not arrive until fall, at which time regular schedules printing, sewing, and binding had become disrupted. The ult was that the paper-bound copies normally issued in October uld not be made available until the March issue, a delay of five nths.

The cloth and leather bindings, involving so much hand work- anship, will be delayed even longer. Latest advices from the nder indicate that the mailing of the cloth-bound issues of RANSACTIONS should be complete in July and the leather ones month later.

All plans and all prospects for the forthcoming 1945 issue con- mplate the regular schedule, to go in the mails during the coming ll. This may be unduly optimistic but nevertheless it will be ttempted—and accomplished, barring unforeseen emergencies tside the control of the Society.

Local Committees Activate Postwar Construction Survey

TO SPEED completion of plans for postwar construction, in keep- g with the faster tempo following V-E day, the Society's Com- ittee on Postwar Construction has mailed from its headquarters nstruction handbooks and construction survey check sheets to ll Local Section officers and members of Section Committees on ostwar Construction. This literature is identical with that eviously sent out by the national headquarters of the Committee r Economic Development to its local community organizations. his Committee has over 2,800 local organizations throughout the nited States, and these local groups are depending upon the ociety's 64 Local Sections to join with them to make an effective rvey.

This survey is designed to show the status of plans for postwar nstruction in the fields of industry, commerce, agriculture, and ublic works. An independent survey of plans for postwar housing ill be made soon, using sampling methods devised by the Bureau f the Census. Private construction's goal is $10 billion in com- leted plans ready for bids for the first postwar year, while public nstruction's goal is $5 billion in completed plans ready for bids. f the Society's Local Sections cooperate as expected, the C.E.D. rvey should prove invaluable in stimulating prompt completion f private plans and thus preventing postwar unemployment in the nstruction industry.

The Engineer in Foreign Service

XV. Late News from Okinawa

By LT. WALTER A. BROWN, ASSOC. M. AM. SOC. C.E.
NAVAL CONSTRUCTION BATTALION

I AM STILL with the same Construction Battalion in the capacity of Personnel Officer, which incidentally is a headache but interesting, and going on my fifteenth month overseas. For a change, just at the present time censorship permits me to say a little about location, etc.

My longest stay was in the Admiralty Islands. From there we went to Guadalcanal and were attached to a Marine Division which became a part of the forces invading Okinawa in the Ryukyus. Hence I am now in the latter place and freezing after a year in the tropics.

We came up from the "'Canal" on an LST, taking about three weeks for the voyage. It was rough most of the way and although I didn't get seasick, I got knocked around a bit. We left a rear echelon in the "'Canal" with our records, etc.

As you probably read, the initial landings were made almost without opposition. That was surprising too because the terrain is ideal for defense. The naval bombardment, of which I witnessed the last phase the morning of L-day, probably had much to do with it. The fighting seems to be getting tougher now, particularly in the south near Naha, which is the Army sector. Have seen a lot of Jap planes shot down nearby, otherwise my own experiences are nothing to write of. Our function has been, and is primarily, the maintenance and construction of roads to supply the front. We also had a hand in repairing the —— airfield.

The island is very densely populated although men of fighting age are conspicuous for their absence. The civilians were badly frightened at first but now act half bewildered and sort of in awe of us. They bow and wave politely but don't show any real friendliness. The kids, however, are wide-eyed with wonder and seem to enjoy the situation. They have already learned to beg and to use a few English words. They seem to get along great with the Marines.

Practically all the arable land is divided up into small plots and terraced. Vegetables, grains, rice, and sugar-cane are grown. The island is really scenic. It seems to be largely limestone with low hills in the center of the island and sloping alluvial plains along the shore. There are many wind-swept "Monterey" pines which make the place look like the postcard scenes of the Jap homeland. There are many small villages which evidently were very attractive before they were overrun and smashed up.

One interesting thing here is the existence of many large burial vaults or tombs constructed centuries ago, some presumably B.C. The Okinawans are supposed to be of Asiatic descent and their ancestors constructed these vaults. They are very large and ornate, built of masonry cemented by a cement for which the formula is evidently forgotten. A family's dead are placed in these tombs for two years, then removed, the remains washed in alcohol, and the bones placed in a fancy glazed pottery urn which is again replaced in the tomb.

Well, this letter is getting lengthy and rambling. Also air-raid sirens are sounding all over the place so will close and see what gives.

XVI. With the Seventh Army

By MAJ. RAY STOKES

I AM now with the Seventh Army in Alsace, and have seen enough of the horrors and misery of war to aptly exclaim as Sherman once said. As one of my men so correctly put it today, "I'd rather spend two or more years over here than have the same thing happen at home." Many of the villages in this section are leveled from artillery and aerial bombardment, unpeopled except for the ghosts of those who used to live there. It gives one a creepy feeling to go sliding through such a town at night with no lights on my jeep. Night shadows easily turn into full-sized Jerries if one is tense enough. The biggest joke that we have on one of our junior officers is the night he mistook a grove of trees for a Jerry patrol and emptied his tommy-gun at them—except he forgot to raise his gun high enough and shot his jeep full of holes. His nickname is now "Trigger."

The first night we landed in this area we experienced a small "Anzio" beachhead. Along about 3 a.m. we were all awakened by

a loud explosion. "Out-going," we said and proceeded to go back to sleep. After one or more rounds, the guards reported that "incoming" shells were landing close by. At that everyone moved to the cellar. Later we learned that the closest one landed 100 yd away, but even that's too close for green troops. After that first experience, we always listen before deciding whether or not the shells are "incoming" or "outgoing" mail.

About our work, I can't say much except that we are kept busy doing military engineering tasks. One of the streams in the area assigned to us pulls a "yellow creek" on us once in a while, but I don't have to worry about reading crest markers.

The Germans did some very neat demolition work in their withdrawal. This country is going to have a lot of engineering and construction work going on when this is all over. Our young engineers, instead of going to South America for experience, will be coming to Europe. They really did some wonderful engineering in this country before the war. I saw one project in which a railroad, a canal, and a highway all crossed, one above the other. The canal was in the middle. Speaking of canals, they have them everywhere. The highways are good, but designed for a smaller automobile than our standard. The bottlenecks in their (French) traffic system are the ancient towns and cities through which they run. Each town is like the next—narrow crowded streets, no sidewalks (except one now and then), houses built to the edge of the street, and everything very, very old. The buildings are all of masonry construction. I have yet to see one of frame construction except perhaps a hay shed. We tore down an 800-year-old castle tower recently because it had been damaged by shell fire and was endangering passers-by. These villages all look as though the buildings were 800 years old or better.

[*Condensed from March 1945 "Tennessee Valley Engineer," publication of the Society's Tennessee Valley Section.*]

XVII. Monetary Mixups

By LT. GEORGE ECKMAN, JUN. AM. SOC. C.E.

PREVIOUS to my last letter I had been working with a mobile repair unit that covered all of Africa and the Near and Middle East. I used to get to Italy quite a bit but haven't been there since the line got past Rome. Up until a couple of months ago I was working on B-29's in India and China, but now I'm back on the Gold Coast. After 13 months of jungle and desert they decided that I needed a rest and change so now I'm what you call the "desk model" variety engineering officer. It's a soft job in comparison to my previous assignment. I used to fly well over 100 hours a month, live in jungles or desert for days on C or K rations, work an average of 12 to 19 hours a day and keep constantly exposed to malaria, plague, cholera, sleeping sickness, and dysentary, to say nothing about Japs and Jerries. Somehow or other I seem to prefer that job to the one I've got now. It's altogether too soft. The food is too good, we get all the liquors we want at $2.00 a quart, plenty of good movies and U.S.O. shows, a good P.X. with plenty of cigarettes (popular brands) at 5c per pack, a local G.I. radio station that transmits all the good radio programs from home sans the commercials. If it weren't for the shortage of white women at this post I'd buy some real estate and settle down for a long war.

I just got back from a 14-day leave in Johannesburg, Union of South Africa, and had the time of my life there. I got 14 days, not counting travel time from here down and back. For that reason I made part of the trip by train in order to see more of the country and get a good look at the Victoria Falls. Since I have never seen Niagara I cannot draw a comparison, but I will say that Victoria is really something worth seeing.

The train ride was from Elizabethville, Belgian Congo, to Johannesburg and took 5 days and nights. (By plane it would take 5 hours.) The train travels at the breakneck speed of 30 miles per hour and stops every 25 miles for at least one hour.

Traveling in Africa gives one some good experience in the different monetary units of Europe. In West Africa we use the English system based on the shilling. At first it's confusing so you ask a limey to explain it to you. "It's very simple, old chap," he says, "you see the basic unit is a shilling. Now there are 12 pence to the shilling and 20 shillings to the pound. We have two coins called a sixpence and a threepence (pronounced thrupence). Each penny is divided into halves (pronounced hay-pence) and quarters (pronounced farthings). A crown is 5 shillings, but we don't have such a coin; however, we do have a half crown which is equal to two and six (2 shillings, 6 pence). A guinea is worth 21 shillings, wh is a good round figure because it's equal to one pound and 12 pen But in case you think it's confusing why don't you use the sim method of calling the coins by their nicknames such as 'Tickey' pence); 'Ten bob' (half a pound) and a 'quid' (20 shillings o pound). We use this system because it's so much more conveni in bookkeeping and accounting. All you have to do is remem that for every multiple of 12 you add one to the shilling colu and for every multiple of 20 you add one to the pound colu It's just as easy as adding a column of degrees, minutes and secon or weeks, days, and hours." And I used to think it was to computing week-second-feet on leap years.

But after 15 months of English currency you get used to it, you make a trip to India. You stop off in Egypt and they "piastres" (approximately 4¢). The French territories use "franc" (2¢). Italian territories use the "lire" (1¢) and the dians use the "rupee" (30¢). Fortunately we have finance offic at each port so you can get the money changed very easily. So of the 50-deg parallel there are no permanent U.S. Army troops you have to go to the local bank. This I did when I got to Eli bethville. I gave the clerk a $100 Treasury check and asked $50 worth of South African currency and $25 worth of Rhodes and Congo currency each. He could not speak English and I ca speak French. Well he started to convert dollars to francs a francs to shillings, but the banks split hairs and use exact conve sion figures like one pound equals $4.055 and a franc is equal $0.238. He worked for almost half an hour converting and addi and dividing. He had it almost figured out and was ready to d duct the tax, duty, fees, etc., and reconvert into francs when discovered that all this time he had been working on a machi that was calibrated for Egyptian piastres. In the meantime t line was getting longer and the people at the window were i patient. Finally the whole staff at the bank went to work on When they got it all straightened out my buddy stepped up to t window and asked them to cash his check for $117.36. When t teller saw this he declared a bank holiday while two other assistan carried him off in a strait-jacket. We did it all for the laugh b came darn near causing an international incident.

The best thing I have ever seen in the way of adding machines the abacus used by the Chinese banks. They can add up a colum of figures faster than you can on a Monroe calculator.

[*Condensed from March 1945 "Tennessee Vally Engineer," pu lication of the Society's Tennessee Valley Section.*]

XVIII. A Yank in Rome

By MAJ. JOHN HAROLD BAUER, ASSOC. M. AM. SOC. C.E.

AT LAST I am having that long rest we all cherish so much b not under the conditions and circumstances one might choose—a this to explain that I am on the flat of my back recuperating fro that despicable illness, hepatitis with jaundice. Here in Italy t filterable virus responsible seems to be more potent than the o familiar in the States. The only cure known is long, long bed re with a fat-free diet. These the hospital is giving me.

Bedded down in a small ward with six other officers sufferi with the same malady, I can wish for nothing other than to be w and back on the job. I am glad to be in a ward for the oth officers keep me company. We have invented a number of speci diseases to pass the time. Just now the favorite malady is "so towel." Two or three men in the ward agree they are sufferi from it. Thus you see most of our time is taken up with nonsens

Leaving the hospital now, I want to retrace my steps for a fe minutes to sum up the wonderful trip I had to Rome while I w still young and healthy. When I went to Rome I visited Cook agency and hired a guide to take me around the city. He to our small party all over the city showing us everything that tourist normally wants to see. Most of it went in one ear and ou the other. I remember many beautiful statues and fountain Wherever you look it seems there is a statue of a she-wolf with t two babies being nourished—Romulus and Remus. I do not lik it but it is everywhere and in every shop window. I remember t city as a whole and a spirit of comfort being there. Other than t city itself, I care to remember the Vatican, the audience given b the Pope, St. Peter's, St. Paul's, and St. John's and above ever thing else the Sistine Chapel, the loveliest thing in all the world

[*Condensed from January 1945 "Tennessee Valley Engineer," publication of the Society's Tennessee Valley Section.*]

Hawaii Section Recommends Improvements

CONSTRUCTION of sorely needed additions to the sewerage system of Honolulu was recommended by the Hawaii Local Section on March 21. The recommendation, which followed a study made by the Section, was sent to the Governor of the Territory, the President of the Senate, the Speaker of the House, and to local officials. The study of facilities had revealed extremely inadequate sewage collection and disposal systems. The recommendation further proposed financing of the work by sewer rental rates or service charges.

At the same session the Section also recommended certain improvements to the public docks and wharves deemed essential to the public interest and urged the reactivating of the Territorial Planning Board. The Section took action on these matters after recognition of the need for careful analysis and long-range planning by a permanent staff of technical experts in the Territory of Hawaii.

Correction for Yearbook

THROUGH an error, the name of Henry Stevenson Miller, M. Am. Soc. C.E., was omitted from the alphabetical listing of the membership in the Society's 1945 Yearbook. Mr. Miller's name should have appeared as follows:

Miller, Henry Stevenson (Assoc. M. '26; M. '42), Senior Civ. Engr., Sewers and Paving Div., Board of Public Service, 300 City Hall (Res., 2349 South 39th St.), St. Louis 10, Mo.

Appointments of Society Representatives

THORNDIKE SAVILLE, M. Am. Soc. C.E., was appointed the Society's representative at a meeting of the Research Board for National Security, a recently established division of the National Academy of Science.

News of Local Sections

Scheduled Meetings

FLORIDA SECTION—Joint dinner meeting with the Jacksonville Engineering Professions' Club and the American Society of Military Engineers at the Seminole Hotel on June 7, at 7 p.m.

LOS ANGELES SECTION—Dinner meeting at the University Club on June 13, at 6:45 p.m. (President Stevens to be the speaker.)

LOUISIANA SECTION—Meeting at the St. Charles Hotel on June 5, at 8 p.m.

MIAMI SECTION—Dinner meeting at the Southern Tavern on June 7, at 7 p.m.

NEBRASKA SECTION—Dinner meeting on June 5, at 6:45 p.m.

OKLAHOMA SECTION—Luncheon meeting in the Y.W.C.A. Bldg., on June 16, at 3 p.m.

PHILADELPHIA SECTION—Dinner and meeting at the Engineers' Club on June 12—dinner at 6 p.m.; meeting at 7:30 p.m.

SACRAMENTO SECTION—Regular Tuesday luncheon meetings.

SAN DIEGO SECTION—Dinner meeting at the U.S. Grant Hotel on June 14, at 6:30 p.m.

SAN FRANCISCO SECTION—Dinner meeting at the Engineers' Club on June 19, at 5:30 p.m. (President Stevens to be guest of honor and speaker.)

TENNESSEE VALLEY SECTION—Spring meeting at Ferris Hall, University of Tennessee, on June 9, beginning at 9:30 a.m. (Subject of the meeting will be "Postwar Plans.")

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Adolphus Hotel on July 2, at 12:15 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on June 11, at 12:15.

TRI-CITY SECTION—Social meeting at the Blackhawk State Park Inn on June 16, at 7:15 p.m.

Recent Activities

ARIZONA SECTION

At the annual spring meeting of the Section, which took the form of an all-day session held in Tucson on April 28, aid in the postwar employment of engineers was planned. William Becker, who has had experience in the past in securing employment for engineers, was appointed chairman of a committee organized for the purpose, and it is expected that he will receive financial and other support from the Section. The list of speakers included J. H. Gardiner, Society Director from District 11, who gave a résumé of Society activities; G. S. Sykes, city engineer of Tucson, who explained the rôle of infiltration in surface runoff; Sterling S. Green, chairman of the Los Angeles Section's Committee on Employment Conditions, who cited problems encountered in the formation of professional engineering employee bargaining groups; John C. Park, professor of highway engineering at the University of Arizona, who gave an illustrated talk on aerial photographic mapping; and G. E. P. Smith, agricultural engineer for the Arizona Agricultural Experiment Station, who predicted the future of irrigation in Arizona in relationship to the use of water from the Colorado River.

BUFFALO SECTION

The principal feature of the April 18 luncheon meeting was a talk by Frank Miller, of the Ingersoll-Rand Company. Mr. Miller spoke on the use and operation of the company's Calyx Core Drill—an abrasive process that utilizes chilled shot. His talk was profusely illustrated with slides, showing work on mines and dam sites in Canada, the United States, and Brazil.

CENTRAL ILLINOIS SECTION

Three Society officers—President Stevens, Secretary Seabury, and E. E. Howard, Vice-President from Zone III—were guests of honor of the Section at the dinner meeting held on April 18. Mr. Stevens discussed recent activities of the Society, with particular reference to the work of its committees, and emphasized the importance of fundamental research. Mr. Seabury gave a résumé of the work of the Society and its staff, while Mr. Howard spoke on the functions of the Board of Direction.

CENTRAL OHIO SECTION

Members of the Central Ohio Section entertained President Stevens and Secretary Seabury at a dinner meeting on April 23. The former developed the theme, "Know Your Society," while Mr. Seabury's subject was the work done at Society Headquarters.

CINCINNATI SECTION

There were two April meetings of the Section. The first of these—a joint session on the 12th with local groups of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers—consisted of an inspection trip and dinner meeting. The U.S. Engineer Office in Cincinnati had arranged for an afternoon visit to the Mill Creek Barrier Dam. At the evening meeting Robert C. Vogt, principal engineer for the U.S. Engineer Office, discussed the city's flood-control problems, emphasizing the possibilities of control in Mill Creek Valley. On April 20, Messrs. Stevens, Seabury, and Howard were dinner guests of the Section and speakers at the special meeting that had been arranged for the occasion.

COLORADO SECTION

Seven staff members of the Kaiser Company's Denver plant were guests of the Section for its April meeting, and all spoke briefly on different items produced at the plant. Another guest of honor and speaker was Society Director Fred C. Scobey, of Berkeley, Calif., who discussed the status of collective bargaining in the Society. When the meeting adjourned the group enjoyed an inspection trip to the Kaiser Company's ordnance plant, where they witnessed the production of 8-in. and 155-millimeter shells.

DULUTH SECTION

Motion pictures on a variety of subjects, ranging from the laying of transcontinental telephone cables to the battles for Moscow and Stalingrad, were shown at the March 19 meeting of the Duluth Section. By special vote the members of the Section chose the timely topic of the Dumbarton Oaks Plan for their April meeting,

the speaker being James G. Nye. Mr. Nye, who has made a study of the plan and addressed other civic bodies in Duluth on the subject, discussed the background that led to the proposed agreement, the arrangement for voting rights, and the purpose of the San Francisco Conference in developing the scheme.

FLORIDA SECTION

Section members who braved the disagreeable weather on April 6 enjoyed an interesting and educational inspection trip to the properties of the Rutland Mining Company of Florida. The entire process of extracting heavy minerals from the sands was observed. The mining is a surface operation; excavating is done with draglines, and the sand is then pumped to the wet mill. Here the mineral concentrate is separated by the spiral gravity process and started through a dryer, while the sand is pumped back into the excavated area. After the concentrate is dry, the minerals are separated by electromagnetic and static separators. Following inspection of the mills, the separation process was reproduced in the laboratory with pilot equipment. During the chicken dinner that concluded the occasion, the general manager of the company discussed the evolution of mining methods and answered questions concerning the local operation.

HAWAII SECTION

The Hawaii Section reports that there were two technical meetings in March, and that discussion at both centered about engineering improvements for the city of Honolulu. On the 1st, Harrison P. Eddy, Jr., Boston (Mass.) consultant, presented his plan for the repair and extension of the city's sewerage system. His talk was followed by a discussion from the floor. Later in the month Benjamin F. Rush, former president of the Section, described current plans for repairing and increasing the facilities of Honolulu Harbor. Mr. Rush is chairman of the Board of Harbor Commissioners of the Territory of Hawaii.

INDIANA SECTION

On April 19 the Indiana Section entertained President Stevens, Vice-President Howard, and Secretary Seabury at a joint meeting with the Purdue University Student Chapter. All three spoke, Mr. Howard directing his remarks especially to the students. During the evening the Section's annual award of Junior membership in the Society was presented to Walter Lum, adjudged the outstanding civil engineering student at Purdue. Another award—for the best paper published in 1943 by the Highway Research Board of the National Research Council—went to D. J. Belcher for his paper on "Engineering Significance of Soil Patterns." Mr. Belcher is a consultant to the War Department.

INTERMOUNTAIN SECTION

A joint meeting of the Intermountain Section and the Ogden Engineers Club was called to order at Ogden, Utah, on April 16. On this occasion the technical program consisted of a talk by Col. Frank M. Browning, nephew of George M. Browning, of machine gun fame. Colonel Browning discussed transportation problems encountered in getting Army supplies to Russia. During the evening a chorus presented a number of musical selections.

ITHACA SECTION

Two joint meetings of the Section and the Cornell University Student Chapter were enjoyed in March. On the 8th, the group heard a talk on "Properties and Uses of Air-Entraining Cement." This was given by J. C. Pearson, of the Lehigh Portland Cement Company. A talk by E. F. Rohwedder, of the U.S. Engineer Office, comprised the technical program at the meeting held on March 29. Mr. Rohwedder's subject was "Airfield Pavements and Foundations."

KANSAS CITY SECTION

The Kansas City Section reports two interesting dinner meetings. On March 23 George E. Zeigler, research associate for the Midwest Research Institute, spoke on the subject of "Research Narratives." As an example of the results of modern research, Dr. Zeigler demonstrated the electric-wire recorder developed at the Armour Research Foundation in Chicago. He had recorded part of the entertainment program that preceded the technical session. A number of V-12 students in training at the University of Kansas were guests of the Section at the meeting held on April 20. Following dinner and a special musical program, Col. Thomas D. Rogers gave a talk on the Bailey Bridge. Colonel Rogers, who is connected with the Command and General Staff School at Leavenworth, Kans., was able to speak from first-hand experience with the bridge in Italy and France.

LOS ANGELES SECTION

The largest turnout of the year—183 members and guests—assembled on April 11 to hear a program devoted to the Mexican Water Treaty. The first speaker was Representative Carl Hinshaw, a member of the Section and the only civil engineer in Congress. Mr. Hinshaw spoke briefly of his interest in the treaty and emphasized the need for more engineers and technical men to serve in the legislative service of the country. The other speakers were C. C. Elder, hydrographic engineer for the Metropolitan Water District, and Mr. Mathews, deputy city attorney of Los Angeles, pinch-hitting for James Howard, who was unable to be present. Both gave interesting side lights on recent Congressional hearings on the subject and emphasized the fact that the proposed treaty may result in serious water shortages in all the Western states.

LOUISIANA SECTION

There were over a hundred guests at the April meeting of the Louisiana Section, which took place in New Orleans on the 26th. The feature of the occasion was an illustrated lecture by Col. Elliott J. Dent, U.S. Army (Retired), who spoke on the Tidewater Channel from the Inner Harbor at New Orleans to the Gulf of Mexico. Colonel Dent is now a consulting engineer, with headquarters in Washington, D.C.

MARYLAND SECTION

A talk on the history and development of shipbuilding in Baltimore comprised the technical program at the April 26 meeting of the Maryland Section. This was given by S. S. Rabl, chief hull outfitting draftsman for the Bethlehem Sparrows Point Shipyard, Inc., who pointed out that the city has been a great shipbuilding center since the days of the famous "Baltimore Clippers."

METROPOLITAN SECTION

On April 18 members of the Metropolitan Section heard Lt. Gen. Eugene Reybold speak on the topic, "The Inland Waterways of the United States in War and Peace." General Reybold, who is Chief of Engineers, outlined the activities of the Corps of Engineers in regard to the inland waterways, mentioning particularly the floods that were spreading, even at the time of the meeting, through the Red and Arkansas River basins. He also expressed the opinion that Congress is favorable to the development of plans for flood control projects before the end of the war so that work can be begun as soon as hostilities cease.

Members of the Junior Branch of the Section recently enjoyed a trip to inspect the shield tunnel headings on the Brooklyn side of the Brooklyn-Battery Tunnel. The group was conducted by Denzil W. Coe, resident engineer for the New York City Tunnel Authority, and Harry Stripling, general superintendent for the contractor, the George H. Flinn Corporation.

MICHIGAN SECTION

An illustrated talk on the probable effects upon the United States of the postwar industrialization of backward countries was presented by William H. Adams at the May 4 meeting. Mr. Adams, who is engineer for the Stan-Steel Division of the Great Lakes Steel Corporation, Detroit, emphasized the important relationship between the amount of goods imported and the national income of a country. Part of the meeting was devoted to business discussion.

NEW MEXICO SECTION

At the April meeting of the New Mexico Section—held in Santa Fe on the 26th—W. B. Catchings, design and specification engineer for the New Mexico State Highway Department, presented a paper on the design and construction of airports. Following a general discussion of the paper, Mr. Catchings answered numerous questions concerning construction and operation conditions in Mexico and Brazil. Some informal discussion on the subject of collective bargaining concluded the meeting.

NORTHWESTERN SECTION

At the May meeting the Section followed its annual custom of presenting engineering handbooks to the outstanding civil engineer

students at colleges in its environs. These prizes went to Oliver Billings, J. S. Holdhusen, and L. A. Dusche, of the University Minnesota, and Arvin R. Riveland, of the University of North kota. In presenting the prizes, George J. Schroepfer spoke on dent Chapter activities, and Mr. Billings responded briefly for Student Chapter. The technical program for the occasion con- ted of a talk by John M. Connolly on postwar federal taxation. Connolly is secretary and general counsel of the Minnesota ning and Manufacturing Company, St. Paul.

Oklahoma Section

Part of the April meeting of the Oklahoma Section was devoted business discussion. Two members of the faculty of Oklahoma gricultural and Mechanical College—Clark A. Dunn and J. E. thers—then spoke. The former gave a timely talk on the Bret- n Woods Agreement, while Professor Lothers read a paper the subject, "Torsion in Steel Spandrel Girders and the Moment using It."

Oregon Section

Guest of honor and principal speaker at the March meeting of e Oregon Section was President Stevens, who discussed the ganization of the Society, with particular reference to the war- me activities of several standing committees. Mr. Stevens com- ented briefly on the Founder Societies' plan for the demilitari- tion of Germany and Japan, and also discussed the work of the gineering Foundation. Two official war films, released by the S. Army, were then shown. One, entitled "Back Door to Japan," strated difficulties encountered in the Burma theater of war, hile the other, captioned "Yankee Noodle," depicted ingenious vices developed under war conditions near the fighting fronts.

Pittsburgh Section

The Pittsburgh Section reports two meetings in April. The first these took place on the 20th and was a joint session with the civil tion of the Engineers' Society of Western Pennsylvania. A mposium on wind tunnels was the feature of the occasion, the akers being J. O. Jackson, A. B. Sanderson, L. A. Idle, and R. T. y, all of the Pittsburgh Des Moines Steel Company. "Presi- nt's Night" was celebrated on April 25, with a dinner for esident Stevens and Secretary Seabury. Both discussed interests d activities of the Society.

Puerto Rico Section

The Puerto Rico Section announces that its first technical meet- g of the season took place on May 4. A talk by Dr. R. A. Vonder- r comprised the program for the occasion. Dr. Vonderlehr, who medical director of the Public Health Service, discussed the velopment of a nation-wide public health program, emphasizing rticularly the participation of the engineer.

Sacramento Section

"Recent Developments in Asphalt Engineering" were discussed Victor A. Endersby at the April 10 luncheon meeting of the ction. Mr. Endersby, who is research engineer for the Shell velopment Company at Emeryville, Calif., described the use of phaltic materials in hydraulic work. On April 24, C. O. Green- ood spoke on "Navigation Explorations on the Orinoco and Ama- n Rivers in South America, supplementing his talk by maps and oving pictures.

San Diego Section

At the March meeting of the Section Fred D. Pyle, hydraulic gineer for the city of San Diego, spoke on the requirements for e San Diego River pipe lines and treatment plant. Following s talk and a general discussion of the subject, a resolution was animously adopted, urging that Proposition No. 1 for a bond ue of $6,000,000 for a San Diego River pipe lines and treatment ant be approved. J. L. Burkholder, chief engineer for the San iego Water Authority, addressed the members of the Section on pril 26 on the tropical islands of the Caribbean area. His talk was strated with beautiful colored slides.

San Francisco Section

On April 17 the San Francisco Section celebrated its fortieth an- versary. The speakers were four past-presidents, who re- iewed the developments of four decades, going back to the hartering of the Section on April 28, 1905. Ralph G. Wadsworth overed events of the decade just past, 1935 to 1944; Nathan A. Bowers, the decade, 1925 to 1934; Frank G. White, the years from 1915 to 1924; and Charles Derleth, Jr., seventh president of the Section, went back to the period, 1905 to 1914.

The technical program at the March 22 meeting of the Junior Forum consisted of a talk on "Soil Mechanics and Foundation Engineering" by T. W. Lambe, research engineer for Dames and Moore, of San Francisco. The topic of general discussion was "Shall We Have Compulsory Military Training After the War?"

Tacoma Section

A program entitled "Speaking for Safety" was presented by Robert W. Gilmore at the March 20 meeting of the Section. Following dinner and a business session, Mr. Gilmore described the methods being employed by various industrial organizations to protect their employees from injury, and to secure their cooperation in safety programs. A sound film on the subject supplemented his talk. Mr. Gilmore is safety engineer for the Washington State Department of Labor and Industries.

Tri-City Section

At the March meeting of the Section—held in Moline, Ill., on the 8th—the speaker was Col. Malcolm Elliott, division engineer for the Upper Mississippi Valley Division. Colonel Elliott's subject, which was on a flood-control program for the Upper Mississippi River and its tributaries, attracted an attendance of 104, the largest the Section has ever had. On April 19 the Section met in Davenport, Iowa, to hear Prof. J. J. Doland, of the University of Illinois, speak on the new University of Illinois Airport. Professor Doland is supervising engineer for the airport.

Wyoming Section

On April 28 the Wyoming Section met jointly with the Cheyenne Engineers' Club and the Wyoming Engineering Society in the offices of the Wortham Machinery Company at Cheyenne. The whole group were dinner guests of W. A. Norris, president of the Wortham Machinery Company. Then a motion picture, depicting construction problems on the Alaska Highway, was shown through the courtesy of the Allis-Chalmers Tractor Company. During the evening a resolution expressing opposition to the Senate bill creating a Missouri Valley Authority was adopted.

Student Chapter Notes

Manhattan College

The Student Chapter at Manhattan College continues active. Of special interest to the group was a meeting held on April 11, at which the construction of the Bronx-Whitestone Bridge was discussed. The principal speaker appearing on this program was J. Edmond Tonnelier, engineer in charge of maintenance of the Triborough Bridge, who illustrated his lecture with lantern slides of photographs made during the construction of the Bronx-Whitestone Bridge. During the evening the accompanying photograph of the speaker and some of his audience was made.

RECENT MEETING OF MANHATTAN COLLEGE CHAPTER
Front Row, Left to Right, Thomas Glynn, Vice-President; Prof. John Costa, Moderator; Mr. Tonnelier; Brother A. Joseph, Assistant Moderator; and Francis Sheridan, President

ITEMS OF INTEREST

About Engineers and Engineering

Legal Warranty of Engineers' Boring Data in Contracts

OF INTEREST to engineers and to contractors is the final determination of a series of legal actions in Massachusetts, defining express and implied warranty of boring data in contracts. The work in question was the earth-fill dike for the Quabbin Reservoir of the Metropolitan District Water Supply Commission. Petitioner was the contractor for the work, The Arthur A. Johnson Corporation, and the respondent was the Commonwealth of Massachusetts.

A series of boring data taken by the Commission was available to bidders on this work. There were also test excavations of the borrow material. The sufficiency and proper presentation of this information and the responsibility of the Commonwealth therefor, were the bases for the actions.

The case was originally heard in 1939 before an auditor. His report was reviewed and the case tried in 1941 before Thomas J. Hammond, Justice of the Superior Court. He is the "Judge" referred to in the latest rulings of the Supreme Court. His findings were in favor of the Commonwealth. Subsequently the contractor (petitioner) took the case to the Supreme Judicial Court. He urged exception to Judge Hammond's rulings, alleging breach of warranty through concealment of information in the possession of the Commonwealth (respondent) as to the nature of the subsoil in certain borrow pits from which the material for the Quabbin Dike was obtained. In its present decision (March 30, 1945) the Supreme Judicial Court overruled the exceptions.

The nature of this determination in favor of the State can be shown in part by quotations from this decision. The petitioner urged that its claim originated in contract and rested on a breach of warranty. The contract itself did not warrant the accuracy of the boring plans but instead contained a provision to the effect that the plans were not guaranteed to be correct, and that no allowance would be made for any error in them. The Supreme Court found that "Where, as here, a written contract shows on its face that it comprises the entire agreement and was intended to be a complete and final statement of the whole transaction, then express warranties other than those contained in the contract cannot be added by extrinsic evidence."

"The auditor found and the judge ruled without objection by the respondent that the Commission impliedly warranted that it had disclosed all the material information in its possession relative to the subsoil conditions in the borrow area C to the petitioner before it submitted its bid. . . . In view of the conclusion we reach, we need not decide whether, in the face of repeated warnings to the petitioner that it must draw its own conclusions about the character of the soil, there could be such an implied warranty in the instant case."

"The judge adopted certain findings of the auditor, and upon all the evidence found that the boring plans were true and accurate portrayals of the borrow areas and were drawn according to well recognized and approved engineering practice; that the shovel cuts revealed the true character of the subsoil in the area involved and disclosed numerous boulders deposited in and forming part of a geological formation known as glacial till; that the area ultimately excavated by the petitioner was almost entirely comprised of the same sort of glacial till as was disclosed by the shovel cuts and was a formation common to all of this general area; that glacial till, till, and hardpan are practically synonymous; that the borings were made for the purpose of ascertaining where a quantity of material suitable for the construction of an impervious dike could be found; that the borings and shovel cuts revealed the fact that a large number of boulders would be encountered; that the method of classification of the material obtained from the borings was an accurate method for determining whether the material in the borrow area was suitable for use as impervious fill; . . . . He found that there was no breach of any express or implied warranty, and that neither the commission nor any of its representatives made any false representation or concealed any information whereby the petitioner was deceived or defrauded."

"The judge found that these plans and the shovel cuts as well furnished full information that the overburden was a glacial till containing boulders and that the excavation would be fairly difficult, and that the difficulty experienced by the petitioner in excavating the area was due to the presence of boulders in the glacial till and not to the fact that the term hardpan did not appear on the plans. It would almost seem to be common knowledge that the excavation of glacial till of the character revealed by the shovel cuts in this area would not be easy. If the judge believed that an experienced contractor who had examined the shovel cuts would not be misled by these plans, we cannot say that he committed any error of law in reaching that conclusion."

Part of the interest of this case to Society members is that it exonerates the engineers from any implication of misrepresentation. In addition, it again bears out the forward-looking attitude of many enlightened engineers and contractors that it is to the best interest of all concerned to have available the most complete information on subsurface conditions.

Postwar Central Heating

DETERMINED to solve forever their [do]mestic, commercial, and industrial heat[ing] problems, the City Council of Chisho[lm], Minn., has just passed an ordnance gra[nt]ing a franchise for furnishing central ste[am] heat and electric power to the entire c[ity] from a cooperatively owned plant. T[he] plan was considered doubly attractive b[e]cause it provides an ideal improvem[ent] project for postwar employment.

The franchise authorizes the constr[uc]tion of an adequate steam and electric p[ow]erating plant with the necessary und[er]ground heat distribution lines and elec[tri]cal circuits, just as soon as war product[ion] schedules permit the release of materia[ls].

Steam service will be made available [to] every residential, commercial, and ind[us]trial building, where it can be adapted [to] existing warm-air, hot-water, or ste[am] heating systems. It was brought out th[at] this would eliminate the need for indi[vi]dual furnace stoking and ash handling, a[nd] would abate a smoke nuisance, assuring a cleaner, more healthful community. Pr[e]liminary estimates indicate that the ow[ner] all fuel consumption will be reduced abo[ut] 25%. Another benefit considered was t[he] utilization of extra basement space upo[n] removal of individual furnaces. It w[as] also pointed out that new homes could b[e] spared the expense of basement excavati[on] and construction.

Under the new plan, the residents w[ould] purchase heat—along with electricity, ga[s] and water—from a central source. Chi[s]holm is the first American city to en[act] legislation that will provide city-wide ce[n]tral heating as a postwar project.

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

"ONCE upon a time," mused Profes[sor] Neare, "I was so rightist that I dis[-] proved of the radical $\sqrt{s(s-a)(s-}$ $\overline{(s-c)}$ for the area of a triangle. It ideal, I thot, if each factor ruled by t[he] radical were a perfect square, say:

$$s - a = \alpha^2;\quad s - b = \beta^2;\quad s - c = \gamma^2$$

$$s = \delta^2 = \alpha^2 + \beta^2 + \gamma^2$$

Then the area would be $A = \alpha\beta\gamma\delta$ a[nd] the inscript radius would be $R = \alpha\beta\gamma/\delta$.

"This exile of radicals from the t[ri]angular world benefits partitions by c[e]medians (such that the parts have eq[ual] inscripts), for the length of the cirmedi[an] from A is $d_a = \delta\alpha$ and the subinscr[ibed] radius is $r_a = \alpha\beta\gamma/(\delta + \alpha)$. Furth[er]more, the cirmedian will divide the o[p]posite side rationally, so that

$$BD = (\delta - \alpha)\left(\alpha + \frac{\beta^2}{\delta + \alpha}\right)$$

"Considering the analogous expressi[on] for cirmedians from B and C, it is obvi[ous]

t all are rational fractions which will come integers if we magnify the triangle the ratio of $\delta(\delta+\alpha)(\delta+\beta)(\delta+\gamma)$ to

"If I'd known that, I could have found at perfect scalene triangle you ordered t April," boasted Joe Kerr. "All I uld need is a square equal to the sum of fferent squares."

"Such as $49 = 4 + 9 + 36$," finished l Klater. "Then with $\alpha = 2$, $\beta = 3$, $= 6$, the sides will be 45, 40, and 13 gnified by the product of $7 \times 9 \times 10 \times$, or 8,190."

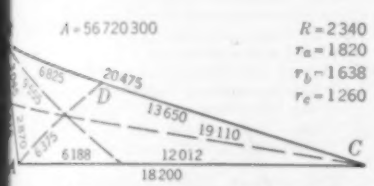
"That would do, but some cooperative nerators permit magnification by only 5 times, giving the answer on the board ig. 1). Incidentally, the partitioned eas are integral, from formulas analogous

$$ABD = \alpha\beta\gamma\delta\,\frac{\alpha^2+\alpha\delta+\beta^2}{(\delta+\alpha)^2}$$

ltiplied, of course, by the square of e magnification factor."

"You said last April there were an in- ite number of such triangles. Can that so if this is the smallest?"

"The fact will be obvious from the entity $\alpha^2 + (\alpha+1)^2 + (\alpha^2+\alpha)^2 \equiv$ $^4 + a + 1)^2$, which will generate a lution for each integral value of α— cept when it is unity, the triangle is

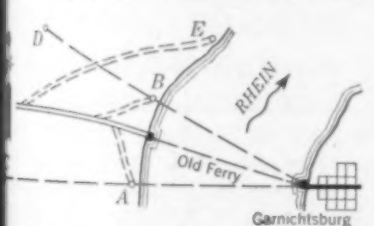


G. 1. A PERFECT SCALENE TRIANGLE

osceles. There are an infinitude of ch identities, each giving an infinitude solutions.

"For next time, we have a treat—a hine-crossing problem brot to us by uest Professor Sir V. Ayer. Just released the censors, Sir V.?"

"No, they never heard of it, Noah. Lt. l E. Dayde came home last week and old me all about it, how his Umpty-fifth ngineers were ordered one afternoon to art bridging the Rhine at dawn and



G. 2. SITE OF GARNICHTSBURG BRIDGE

ow he planned it and did it. The east- ank bridgehead had to be the old ferry ip at Garnichtsburg (Fig. 2). The west- ank slip having been pin-pointed by rry's mortars, he marked alternative butment sites, *A* and *B*. Warned of rtificial fog, he carefully referenced his nes with range poles at *C* and *D*. When he foggy dawn came, suspicious jerries urned the heat on the bank from *A* to *B*, o Al's Major taped a trail to *E* and ordered a bridge from there to the Garnichtsburg slip. Now how did Al run line in the fog?"

[Sir V. Ayer, the Guest Professor, is Howard K. Preston, who hints that a transit does nothing in a fog but magnify it.]

Award Program for Textbooks in Structural Design

AN AWARD PROGRAM to encourage the preparation and publication of textbooks on structural design has been announced by The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio. The Foundation's new project, known as "The $20,000 Award Program for Textbooks Covering Machine and Structural Design for Modern Processes," is made eligible to any person in the teaching profession, in industry, or engaged in private consultation. A manuscript may be submitted jointly by two or more persons. No one person can participate in the writing of more than one manuscript in each class—machine design and structural design.

The awards in the program are divided into two classes: Class A, Machine Design; and Class B, Structural Design. There are three awards in each class as follows:

CLASS A—MACHINE DESIGN	CLASS B—STRUCTURAL DESIGN
First Award, $5,000	First Award, $5,000
Second Award, $3,000	Second Award, $3,000
Third Award, $2,000	Third Award, $2,000

If the Jury of Award so recommends, the first award papers in each class of participants will be published by a recognized publisher of engineering textbooks, and the authors will receive royalties from their textbooks when sold in book form.

Papers will be judged by a Jury of Award drawn from appropriate branches and institutions of engineering education. Selection of the jury will be under the direction of the chairman of the Jury of Award, Dr. E. E. Dreese, Ohio State University, Columbus, Ohio.

Judgment to be made by the Jury of Award in rating the merits of the manuscripts will be based on the factors of (*a*) educational value and utility, (*b*) excellence and modernity of content, (*c*) adequacy in coverage of designing for welding, (*d*) clarity and logic of arrangement, (*e*) completeness and thoroughness of treatment consistent with proper length for collegiate use, (*f*) proper balance of topics in accordance with importance, and (*g*) indications of future progress in the given field.

The Committee on Rules is composed of the following deans of engineering (the first three being Members, Am. Soc. C.E.):

Ivan C. Crawford, Dean, College of Engineering, University of Michigan
H. P. Hammond, Dean, School of Engineering, Pennsylvania State College
S. C. Hollister, Dean, College of Engineering, Cornell University
F. Ellis Johnson, Dean, College of Engineering, University of Wisconsin
Webster N. Jones, Director, College of Engineering, Carnegie Institute of Technology
S. C. Lind, Dean Institute of Technology, University of Minnesota
C. E. MacQuigg, Dean, College of Engineering, Ohio State University
E. J. Streubel, Dean, Polytechnic Institute of Brooklyn
E. E. Dreese, Chairman, Department of Electrical Engineering, Ohio State University

Further details of this new award program for textbooks, which closes May 15, 1946, may be obtained by addressing The Secretary, The James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio.

Planning Pamphlet Issued

A PROGRAM aimed at the attaining of continuing full employment is presented in the booklet, "National Budgets for Full Employment," published by the National Planning Association. Data contained in this booklet indicate that unless steps are taken to close the gap of some $20,600,000,000 which will exist between total national output and total expenditures, by business, government and individuals, full employment cannot continue.

In the foreword of the booklet the object of the report is stated: "We must prepare now for full and continuing employment under peacetime economy. The basis of America's postwar economy should be private enterprise, with the Government acting as impartial referee and effecting fiscal policies through taxation and expenditure programs, such as public works, that will mesh with private undertakings."

Copies of the booklet may be secured by addressing the National Planning Association, 800 21st Street, N.W., Washington 6, D.C. Single copies of the 96-page booklet are 50 cents. Reduced prices are given for quantity orders.

Bulletins Now Available

SEVERAL reports and bulletins of interest to engineers have recently been issued. One of these—the Proceedings of the First Connecticut Traffic Engineering Conference—was prepared as the result of a five-day meeting of state and local officials, in the spring of 1944. This meeting was sponsored by the Bureau for Street Traffic Research (now the Bureau of Highway Traffic) at Yale University. Further information about the Proceedings (131 pages, mimeographed, paper bound) may be obtained from Theodore M. Matson, director of the Bureau of Highway Traffic, Strathcona Hall, Yale University, New Haven, Conn.

Also of interest to highway and road engineers will be a 175-page bulletin, entitled "A Policy on Grade Separations for Intersecting Highways." This bulletin was published by the American Association of State Highway Officials and is available upon application to the general offices of the Association, 1220 National Press Building, Washington, D.C., at $1 each.

The Ohio Water Supply Board, with headquarters at Columbus, Ohio, recently issued a 68-page preliminary report on "Water Supply in Fulton County." This

study is in line with the Board's policy of treating the subject of water supply by individual localities, using the county as the unit of area. Fulton County was chosen as the subject of the report because several of its municipalities have been requesting information concerning their water supplies, reservoirs, and future prospects.

In a somewhat different category is Bulletin No. 807 of the U.S. Department of Labor, entitled "Improvement of Labor-Utilization Procedures." Written from the standpoint of plant management, the bulletin should be of value to all employers as it is based on the actual experiences of a large number of plants during the war period. Copies are available through the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at a cost of ten cents per single copy.

Aviation Engineers Observe Fifth Anniversary

IN THIS WAR—more so than in any other struggle in which our country has been engaged—the engineers of our armed forces are emerging as one of the great factors contributing to our successes. On the fourth day of this month (June) one of the most gallant and hard-hitting groups of these men will observe the fifth anniversary of the creation of their branch—the Aviation Engineers of the Army Air Forces.

Organized in 1940 as an integral part of the Air Forces, and dedicated to the job of bringing the strength of our air arm ever closer to the enemy's vitals, the Aviation Engineers have truly teethed on the difficult, and now again and again do the impossible. No lengthy discourse on the feats they have performed could do justice to the quiet way they have gone about their task of speedily building airports to bring the point of our air power within sword's length of the enemy—airports which were required to be built almost always at the front lines and in some cases, such as in Burma, behind the enemy's lines—airports which often were build by Aviation Engineers who one moment were operating their construction equipment and the next were beating off enemy attacks threatening their work.

To these Aviation Engineers, who fought their way through Africa, Italy, France, and the islands of the Pacific—to these men who have known this war from the first roar of bombs at Pearl Harbor and the Death March at Bataan, CIVIL ENGINEERING extends congratulations and offers best wishes for continued success.

Their Train Was Over Three Years Late

TEXANS along the Gulf and Interstate Railroad (now a fragment of the Gulf, Colorado and Santa Fe, Atchison System) claim a unique distinction for their 44-mile road between Bolivar and Beaumont. In 1903 their 1900 one-round-trip-a-day accommodation train reached Beaumont, its northern terminus, 3 years and 23 days late. This story is vouched for by Ralph Z. Kirkpatrick, of Rochester, N.Y., a former Texan.

As originally built in 1897, the right of way crossed from Galveston Island to the mainland over a low wooden trestle. Thence it followed the coast line fairly closely for about 25 miles before heading northward to Beaumont. During the terrible hurricane of September 9, 1900, which prostrated Galveston, the train barely reached Bolivar, or High Point, on the mainland just across from Galveston. The flood destroyed the trestle and about 30 miles of track; but Bolivar was slightly above the fury of the sea waves and escaped with minor damage.

The wrecked and nearly insolvent road was not sufficiently rebuilt so that the train could proceed further until October 1, 1903. Even now the crossing from Galveston to Bolivar is made on a ferry. Yes, the original train crew and passengers had been released from their lonely haven over three years before.

$17,500,000 Federal Funds for Postwar Planning

The Independent Offices Appropriation Bill, carrying a sum of $17,500,000 for postwar planning, has been signed by President Truman. This money is available now to all state, county, and municipal agencies, except state highway departments, which participate in other federal-aid funds.

These funds are to be directed by Maj. Gen. Philip B. Fleming, FWA Administrator, and apportioned as follows:

> 90% or $15,803,181 in the proportion that the population of each state bears to the total population of all states, and 10% according to the discretion of the administrator. No state shall receive less than 1/2 of 1% of these funds. No interest is to be charged on the money so advanced but it is to be repaid when and if the project is constructed.

Those interested may obtain a tabulation showing the amounts apportioned to each state from their Local Section officers, or from the Regional Directors of the FWA. These Directors, and their addresses, are as follows:

DIV. NO.	REGIONAL DIRECTOR	STATES UNDER EACH DIVISION
1	L. A. Gillett 101 Park Ave. New York 17, N.Y.	Me., Vt., N.H., Mass., Conn., R.I., N.Y., N.J.
2	Henry J. Sullivan Lemon Bldg. Washington 25, D.C.	Pa., Md., Del., Va., W.Va., D.C.
3	Oliver T. Ray 20 Fifth St., N.W. Atlanta, Ga.	N.C., S.C., Ga., Fla., Tenn., Ala., Miss.
4	R. C. Ashton 1506 Civic Opera Bldg. 20 N. Wacker Drive Chicago 6, Ill.	Ohio, Ky., Ind., Mich., Ill., Wis.
5	C. W. Anderson City Hall & County Court House St. Paul 2, Minn.	Minn., Iowa, Mo., N.D., S.D., Nebr., Kans.
6	James W. Bradner, Jr. 710 Electric Bldg. Fort Worth 2, Tex.	Ark., La., Tex., Okla.
7	William H. Cheney 2223 Fulton St. Berkeley 1, Calif.	Nev., Ariz., Calif., Wyo., Colo., Utah, N.Mex., Hawaii
8	L. R. Durkee Room 511 618 Second Ave. Seattle 4, Wash.	Mont., Idaho, Wash., Ore., Alaska

Note: Puerto Rico, the Virgin Islands, and the Canal Zone are assigned to the Central Office of the Bureau.

Purdue Study Shows Shortage of Engineers

PURDUE UNIVERSITY places its engineering graduates with about 400 companies. Uninterrupted requests have been coming in from these companies for engineers with ever-increasing urgency during recent months. To obtain a picture of the present critical shortage of engineering graduates, a communication was sent to about one-third of these companies to ascertain their present shortages and future needs. Names were chosen with a view to securing a good cross section of American industry. Replies received revealed the following:

105 companies replied
8 or 7.6% indicated no need for additional engineering talent
97 or 92.4% companies, including both large and small industries, reported a total need of 4,590 engineers
47 was the average shortage of engineers per company

The companies reporting may be classified as follows:

Aircraft industries	
Chemical, rubber and oil industries	
Construction companies	
Electrical manufacturers	
Machinery and automotive manufacturers	
Railroads and railway supply companies	
Steel and other raw material industries	
Utilities	
Miscellaneous	

This survey, which included only a very small percentage of American industries, revealed an urgent need for 4,590 engineers. This would indicate that the total need by American industry of fully trained engineers is certainly many times the shortage reported—a particularly serious situation since the output of civilian engineers from all engineering colleges of the United States during the present year will be less than 2,000 and will be made up largely of individuals who are physically incapacitated.

NEWS OF ENGINEERS

Personal Items About Society Members

JOHN W. WHEELER, colonel, Corps of Engineers, U.S. Army, at present in Germany, has been awarded the Bronze Star Medal "for meritorious service in connection with military operations against the enemy from January 29 to February 28, 1945." The citation accompanying the award states that "Colonel Wheeler's initiative, resourcefulness, and untiring driving energy, coupled with his intimate knowledge of the technical capabilities of engineer troops and material . . . enabled combat troops to successfully force a crossing of the Roer River. . . ." Colonel Wheeler's home is in Crown Point, Ind.

BOYNE H. PLATT has been named business manager of Iowa State College. He

Build them Faster and Better with *Steel!*

POSTWAR road and bridge projects will approximate 3 billion dollars a year. That's worth going after in a big way.

By using modern construction methods and materials, you can handle a sizeable slice of it. But, you'll have to be prepared to move along fast. America is impatient for her better roads, bridges and super expressways.

Steel will help put you in position to pour more miles of good roadway, open more heavy-traffic bridges than you thought possible in pre-war days.

Why? Because of the lessons learned in bridging streams, laying landing strips, building docks close to the battle fronts, as well as in the construction of contributing home front facilities. Steel's advantages over harder-to-handle, less efficient materials — re-emphasized by its wartime role—will be yours to profit by when your crews begin work on peacetime projects.

STEEL IS BASIC FOR BUILDING

Our engineers are ready now to discuss the application of U·S·S Construction Steels to any phase of your postwar road and bridge building plans. A request will also bring descriptive literature on U·S·S Sheet Piling, U·S·S Bearing Piles or U·S·S I-Beam-Lok Flooring.

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh and Chicago

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

Only Steel can give you these Six Structural Advantages:

- ★ High Strength-Weight Ratio
- ★ Highest Modulus of Elasticity
- ★ Extra Toughness and Shock Resistance
- ★ Versatility of Application
- ★ Great Durability
- ★ Ultimate Economy

USS STEEL
UNITED STATES STEEL

UNITED STATES STEEL

til lately he was superintendent of buildings and grounds at that institution.

DONALD E. STEARNS recently severed his connection as assistant engineer for Fay, Spofford and Thorndike, of Boston, Mass., in order to accept an appointment as professor of civil engineering in the College of Applied Science at Syracuse University.

MYRON T. JONES has established an engineering practice in Columbus, Ohio, with offices at 2901 North High Street. He will specialize in postwar planning, municipal engineering, flood control and drainage, and topographic mapping.

RICHARD S. HOLMGREN is now principal assistant engineer for the San Diego County Water Authority, with headquarters in San Diego, Calif. He was formerly project engineer for the shipbuilding division of the Pacific Bridge Company, at Alameda, Calif.

HORATIO S. MATTIMORE, senior civil engineer for the U.S. Navy, has been transferred from the Bureau of Yards and Docks at Wilmington, N.C., to the Public Works Department of the Naval Operating Base at Terminal Island (San Pedro), Calif.

HARRY P. McKEAN announces that he and other former employees of the Harza Engineering Company, of Chicago, have established an engineering and consulting practice under the name of Erik Floor and Associates, with offices at 139 North Clark Street, Chicago 2, Ill. The organization will specialize in hydroelectric developments, power plants, transmission lines, switching stations, distribution systems, pumping stations, dams, and other hydraulic structures.

WALTER D. BINGER has resigned as Commissioner of Borough Works for Manhattan in order to become vice-president of the City Investing Company in charge of the construction program that the company expects to undertake in the near future. Mr. Binger has been in the service of the city since 1934 when Mayor LaGuardia appointed him Deputy Commissioner of Sanitation in charge of the engineering division. Prior to that he had maintained a private engineering practice. Mr. Binger will be succeeded as Commissioner of Borough Works by CHARLES W. WILLIAMS, former assistant commissioner.

CHARLES GILMAN, first vice-president of the Massey Concrete Products Company, New York City, was recently appointed by Governor Edge, of New Jersey, to an eight-year term on the Board of Control of the Department of Institutions and Agencies. Mr. Gilman is now completing his second term as councilman-at-large for the city of Plainfield, N. J. A former Director of the Society, he has been for many years chairman of the Society's Local Membership Committee in his area.

LUCIUS CLAY and EUGENE REYBOLD have received temporary wartime promotions from the rank of major general, U.S. Army, to that of lieutenant general. With the promotion of General Reybold, the Corps of Engineers, for the first time in history, will be headed by a three-star general. General Reybold has been Chief of Engineers since 1941. General Clay was recently appointed deputy to General Eisenhower in the direction of the occupation of Germany.

RICHARD E. DOUGHERTY, vice-president of the New York Central Railroad System, is the recipient of the 1945 Egleston Medal of the Columbia University Engineering Schools Alumni Association for "distinguished engineering achievement." Mr. Dougherty, who is a Vice-President of the Society, was cited as an "eminent, resourceful, and progressive railroad builder and executive," responsible for the New York West Side and the Syracuse and Buffalo improvements. The medal, which goes annually to an alumnus who has distinguished himself in his profession, was presented to Mr. Dougherty at the seventy-fourth annual dinner of the engineering alumni, held in New York on April 19.

ARTHUR B. J. ONDERDONK, lieutenant, Civil Engineer Corps, U.S. Navy, has won a Presidential Citation and Silver Star Medal "for distinguishing himself conspicuously by gallantry and intrepidity in action June 10 and July 10–11, 1944, as a member of an assault unit during the capture of enemy-held islands." The citation further stated that, "His courage and conduct throughout were in keeping with traditions of the Naval service." Lieutenant Onderdonk, whose home is in Kittery, Me., has been put in command of Underwater Demolition Team 14.

WILLIAM C. THORNTON was recently promoted from the rank of major in the Corps of Engineers, U.S. Army, to that of lieutenant colonel. At present he is in the Marianas.

FRANCIS E. TWISS, after twenty months with the Seabees in Alaska, is now in charge of design and construction at the Naval Air Operational Training Center at Jacksonville, Fla. He has the rank of lieutenant in the Civil Engineer Corps of the U.S. Naval Reserve.

HAROLD CONKLING announces that he has established a consulting engineering practice at 108 West Sixth Street, Los Angeles 14, Calif. He will specialize in problems of water supply, ground-water hydrology, appraisals and valuations, and economic studies. Previously Mr. Conkling was deputy state engineer on water rights, with headquarters at Sacramento, Calif.

CHAUNCEY M. HEARN, lieutenant colonel, Corps of Engineers, U.S. Army, has been awarded the Legion of Merit for "exceptionally meritorious achievement in the performance of outstanding service" as Persian Gulf Command liaison officer at Cairo, Egypt. During the period on which the award was based—June 1943 to February 1945—Colonel Hearn was "instrumental in procuring . . . large quantities of materiel, supplies, and equipment, which were vitally needed for the speedy delivery of war materiel to the Russian Army through the Persian Corridor," the citation accompanying his award states. His home is in Worcester, N.Y.

AJUDHIA N. KHOSLA, formerly chief engineer in the Indian Irrigation Department at Lahore, Punjab, India, has been appointed consulting waterways engineer with the government of India at New Delhi, India. In addition, he is chairman of the Commission for Central Waterways and Navigation and Irrigation—a position similar to that of commissioner of the U.S. Bureau of Reclamation.

JACQUES S. MINNOTTE is one of several employees of the U.S. Engineer Office at Pittsburgh, Pa., to whom Meritorious Awards for Civilian Services were recently presented. Mr. Minnotte is assistant head of the construction branch of the Engineer Office there.

FABIAN S. MILLER, until lately deputy city engineer of Palo Alto, Calif., has been named acting city engineer and head of the board of public works. He will succeed L. HAROLD ANDERSON, who resigned recently to become president of the California Railroad Commission.

FRED E. SWINEFORD has severed his connection as director of the Bituminous Concrete Producers Association, at Columbus, Ohio, in order to become chief engineer of the bureau of construction of the Ohio State Department of Highways, with headquarters in the same city.

HAROLD B. GOTAAS is now a colonel in the Sanitary Corps of the U.S. Army, the rank representing a promotion from that of lieutenant colonel. He is director of the Division of Health and Sanitation, Office of the Coordinator of Inter-American Affairs, Washington, D.C.

BURWELL BANTZ, formerly director of the Washington State Highway Department, has been appointed city engineer of Tacoma, Wash.

LACEY V. MURROW, colonel, Air Corps, U.S. Army, has been made an assistant to Maj. Gen. Robert S. McClure, deputy director of the Chinese War Transport Board.

ALBERT B. GOODWIN was recently transferred from the Sante Fe (N.Mex.) office of the U.S. Geological Survey to the Survey's office at Asheville, N.C. He holds the position of associate engineer.

ELBERT K. ABBERLEY has been elected a director of the Turner Construction Company, of New York with which he has long been associated in an engineering capacity.

PHILIP G. BRUTON, brigadier general, Corps of Engineers, U.S. Army, is now Pacific division engineer in charge of military construction in eight Western States as well as engineer for the Ninth Service Command. General Bruton will have two offices—the headquarters of the Ninth Service Command at Fort Douglas, Utah, and his division office in San Francisco, Calif.

WALLACE R. ENGSTROM will head the new aviation division that the Austin Company has established at Cleveland, Ohio. Mr. Engstrom, who is one of the vice-presidents of the Austin Company, has been district manager in the Pacific Northwest since 1933, with headquarters in Seattle, Wash. He will be succeeded in the latter capacity by RICHARD ELLIS, until recently acting manager of the Pacific Northwest District.

LAURANCE E. GOIT has been appointed chief engineer of water works and deputy

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general manager of the Los Angeles (Calif.) Department of Water and Power. In this new post he will administer the system that collects the waters of Owens Valley and Mono Basin and transports them over 300 miles to the metropolitan area. Mr. Goit was previously engineer in charge of water distribution for the Department of Water and Power.

W. R. PARKHILL, chief of the Appraisal Engineering Section in the Land Bank Division of the Farm Credit Administration, with offices in Kansas City, Mo., retired from government service on April 30, and will move to Berkeley, Calif. He is being succeeded by DONALD H. BUSHNELL, who will take over the direction of the work.

OTTO E. ECKERT, engineer of Lansing, Mich., has been elected to membership on the University of Michigan's Board of Regents. Mr. Eckert is general manager of the Board of Water and Electric Light Commissioners of Lansing.

DECEASED

WILLIAM BROKAW BAMFORD (M. '10) consulting engineer and former mayor of Belmar, N.J., died there on April 10, 1945. For many years Mr. Bamford maintained a consulting engineering and architectural practice in Trenton. He saw service in the Corps of Engineers, U.S. Army, in both the Spanish-American War and the first World War, attaining the rank of colonel. Mr. Bamford was, also, the recipient of the Distinguished Service Medal of the American Red Cross for his public welfare work.

LANSING HOSKINS BEACH (M. '05) major general, U.S. Army (retired), Pasadena, Calif., died in an Army hospital there on April 2, 1945. General Beach, who was 84, was a West Point graduate in the class of 1882. From then until his retirement in 1924 he was promoted through all the grades (from second lieutenant) to command of the Corps—with the title of major general from 1920 to 1924. During the first World War he served overseas, and in recent years he was on the Los Angeles County Housing Authority.

JAMES HARVEY BRIGGS (Affiliate '25) of San Antonio, Tex., died suddenly on February 20, 1945, at the age of 60. Though born in Brooklyn, N.Y., Mr. Briggs spent most of his life in Texas. Shortly after the first World War—during which he served overseas with the rank of first lieutenant—he became associated with the Trap Rock Producers at Knippa, Tex. At that time he started a publication—"Trap Rock Chats"—for which he became widely known in Texas. More recently he was sales engineer for the Servtex Materials Company at New Braunfels, Tex.

GILBERT JAMES BELL (M. '97) retired engineer and former Director of the Society, died at his home in Chicago, Ill., on April 29, 1945. His age was 91. Mr. Bell was with the Atchison, Topeka and Santa Fe Railway for over forty-five years—he had been assistant engineer at Kansas City, Mo., and for much of this long period of service was district engineer at Topeka, Kans. At the time of his retirement, about eight years ago, he moved to Chicago. He was an authority on river control and protection works and bridge construction. Long a member of the Society, Mr. Bell served as Director from 1927 to 1929.

GILBERT JAMES BELL

WALLACE LYON CALDWELL (Assoc. M. '20) president of the Alabama Asphaltic Limestone Company, of Birmingham, Ala., died in that city on April 2, 1945. He was 56. From 1914 to 1921 Mr. Caldwell was district manager of the Pittsburgh Testing Laboratory; from 1921 to 1925, president of the Kentucky Rock Asphalt Company; and from 1925 to 1928, vice-president of the Peoples Light and Power Corporation, New York. From the latter year until his death he was president of the Alabama Asphaltic Limestone Company.

OSCAR FREDERICK DALSTROM (M. '21) assistant chief, Way and Structures Section, Transportation Equipment Division of the War Production Board in Washington, D.C., died in Princeton, Ill., on April 13, 1945. Mr. Dalstrom, who was 73, was connected with the Chicago and Northwestern Railway from 1906 until his retirement in 1942. For much of this period (1917 on) he was engineer of bridges in Chicago. About two years ago he became connected with the War Production Board.

HAROLD STUART FISHER (Assoc. M. '21) engineer for the Southern California Edison Company, of Los Angeles, Calif., died on February 21, 1944, though the Society has just heard of his death. His age was 65. Mr. Fisher spent much of his career as engineer for the Southern California Edison Company.

JOHN HENRY FREDERICKSON (M. '10) contractor and engineer of Oklahoma City, Okla., died there on March 21, 1945. Mr. Frederickson, who was 77, was in charge of the construction of state capitols for Oklahoma, Idaho, and Utah. He had been city engineer of Oklahoma City and, for some years, was with James Stewart and Company, serving as district manager at Oklahoma City and Houston, Tex.

RALPH LYMAN HARDING (M. '31) [illegible] of the Cleveland (Ohio) engineering [illegible] of Wilbur Watson and Associates, died [illegible] that city on April 24, 1945. Mr. Hardi[illegible] who was 62, was in the Philippines fro[illegible] 1906 to 1917 as division engineer in cha[illegible] of construction for the Manila Railro[illegible] Company. During the first World W[illegible] he served overseas with the A.E.F., [illegible] taining the rank of major. Upon his r[illegible] turn to the United States, he joined th[illegible] Watson Engineering Company, whi[illegible] later became Wilbur Watson and As[illegible] sociates. With the exception of two leav[illegible] of absence when he devoted himself [illegible] public service, Mr. Harding was ass[illegible] ciated with this firm until his death [illegible] since 1927 in the capacity of partner.

ANDREW PHILIP HARTMANN (M. '[illegible] civil engineer and city surveyor of Tuck[illegible] hoe, N.Y., died at his home there on Apr[illegible] 18, 1945. His age was 76. Early in h[illegible] career Mr. Hartmann was engaged on su[illegible] veying projects for New York City, an[illegible] later was city engineer for Yonkers, N.Y[illegible] He developed residential areas in Yonke[illegible] and worked on various construction pro[illegible] ects in Westchester County. He ha[illegible] been in Tuckahoe for over fifteen years.

ROBERT ELMER HORTON (M. '10) co[illegible] sulting engineer and authority on hydra[illegible] lics, died at his home at Voorheesvill[illegible] N.Y., on April 22, 1945, at the age of [illegible] From 1900 to 1906 Mr. Horton was di[illegible] trict engineer for the U.S. Geological Su[illegible] vey, and from 1906 to 1911 hydraulic e[illegible] gineer for the New York State Barg[illegible] Canal. Since the latter year he had mai[illegible] tained a consulting practice. From 191[illegible] to 1925 he was retained as hydraulic e[illegible] pert for the New York State Departme[illegible] of Public Works, and from 1924 to 19[illegible] as consulting engineer for the New Yo[illegible] Board of Water Supply. His other publ[illegible] services included chairmanship of th[illegible] Board of Consultants on Flood Contr[illegible] for the U.S. Department of Agricultu[illegible] from 1940 until his death. Mr. Horto[illegible] was the inventor of a water-level gage us[illegible] a joint for wood-stave pipe, and the auth[illegible] of numerous books and articles on hydra[illegible] lic subjects.

EUGENE CHRISTIAN HULTMAN (M. '2[illegible] chairman of the Metropolitan Distri[illegible] Commission, Boston, died at his summ[illegible] home in Duxbury, Mass., on April 2[illegible] 1945. Mr. Hultman, who was 69, pra[illegible] ticed civil engineering early in his car[illegible] and then entered politics. He had be[illegible] elected to the Massachusetts State Hou[illegible] of Representatives and the State Senat[illegible] and from 1921 to 1926 was a member [illegible] the State Division of Necessaries of Li[illegible] Later (from 1926 to 1930) he was Bost[illegible] Fire Commissioner, and from 1930 t[illegible] 1934 he was Boston Police Commissione[illegible] Since the latter year he had been co[illegible] missioner of the Metropolitan Distri[illegible] Commission.

OSCAR WILLIAM LANZENDORF (Ass[illegible] M. '20) associate engineer for Camp Beal[illegible] Calif., died in Yuba City, Calif., on Apr[illegible] 13, 1945. Mr. Lanzendorf, who was [illegible] was county engineer of Sutter Coun[illegible] from 1919 to 1944. During this period h[illegible] made his home in Yuba City and was [illegible] member of the Sacramento Section. M[illegible]

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Lanzendorf served overseas with the A.E.F. in the first World War, having the rank of first lieutenant.

NORMAN AUSTIN LEECH (M. '43) of Glendale, Calif., died on March 31, 1945, at the age of 65. Born in South Africa, Mr. Leech gained his early engineering experience there, coming to the United States in 1907. From then until 1918 and from 1923 to 1930 Mr. Leech was in private practice—successively, in Seattle, Vancouver, El Paso (Tex.), and Los Angeles. From 1930 to 1933 he was manager for Joseph E. Morgan and Sons, contractors of San Antonio, Tex., and from 1934 to 1938 a member of the St. Louis firm of Leech and Schmidt. More recently Mr. Leech was associate engineer for the PWA at Omaha, Nebr., and examining engineer for the FWA at Jefferson City, Mo.

MATTHEW MARSHALL MANEESE (M. '29) engineer for the U.S. Engineer Office at Pittsburgh, Pa., died on February 3, 1945, at the age of 65. For a number of years Mr. Maneese was in the employ of the City of Pittsburgh—from 1914 to 1926 as division engineer in charge of the domestic service section of the Bureau of Water, and from the latter year to 1943 as principal assistant city engineer. Earlier in his career he had worked on the design and construction of the Pittsburgh water supply, including the Northside Reservoir. About two years ago Mr. Maneese became connected with the U.S. Engineers Office.

EGBERT STEPHEN NEEDHAM (M. '31) a civilian engineer in the employ of the U.S. Army, was fatally stricken in London on March 13, 1945, while attending a meeting of the Institution of Civil Engineers. He was 57. An American citizen, Mr. Needham had lived in England since the last war—for some years as bridge engineer for Sir W. G. Armstrong Whiteworth and Company, of London. Later he represented Air Alexander Gibb and Partners on construction work in Istanbul, Turkey, and other parts of the world. His most recent U.S. Army assignment was in Paris, but he was invalided back to England a few months ago.

ALONZO ORRIN PEABODY (M. '20) contractor of Santa Fe, N.Mex., died in El Paso, Tex., on January 15, 1945, at the age of 58. Mr. Peabody was with the New York State Engineer Department on the design of canal and terminal facilities from 1912 to 1915, and construction engineer for the Acheson Graphite Company at Niagara Falls, N.Y., from 1915 to 1918. Later he was assistant state highway engineer of New Mexico, and for the past fifteen years he had maintained a highway contracting practice—first at Las Cruces, N.Mex., and more recently at Santa Fe.

JASPER MARION PHILLIPS (M. '13) retired engineer of Exeter, Mo., died there on December 22, 1944. Mr. Phillips, who was 80, spent much of his career in railroad work. He had been with the Bristol, Elizabethton and North Carolina Railroad; the Louisiana Railway and Navigation Company; the Chicago, Great Western Railway; the Great Northern Railway, and other lines.

JOHN ARTHUR RENSHAW (M. '38) transportation engineer, Office of Defense Transportation, Interstate Commerce Commission, Washington, D.C., died recently. His age was 56. From 1906 to 1918 Mr. Renshaw was with the City of Philadelphia; from 1918 to 1921, engineer for the Emergency Fleet Corporation; from 1921 to 1927, assistant engineer for the Delaware River Bridge Joint Commission; and from 1927 to 1932, engineer for the Philadelphia Rapid Transit Company. Beginning in 1934, Mr. Renshaw was for some years resident engineer inspector at Philadelphia for the Public Works Administration. About two years ago he became connected with the Interstate Commerce Commission.

HENRY CLAY RIESBOL (Assoc. M. '22) of New York, N.Y., died on April 5, 1945, at the age of 61. From 1910 to 1915 Mr. Riesbol was with the Western Electric Company, of Chicago; from 1915 to 1917, with the Turner Construction Company, of New York; and from 1917 to 1929, with T. E. Murray, Inc., of New York City. Later he was in private practice as a structural designer in the field of concrete, his specialty being the design of foundations for power houses. Mr. Riesbol was the inventor of wall forms and floor forms now in extensive use.

HOLTON DUNCAN ROBINSON (M. '[illegible]) consulting engineer of New York, N.Y., died at his home in Riverdale, N.Y., on May 7, 1945, at the age of 82. A noted bridge engineer, Mr. Robinson was [illegible] member of the firm of Robinson and Steinman, which was formed in 1922. Bridges on which this firm worked included the Mount Hope Bridge in Rhode Island, the International Bridge at Detroit, the Transbay Bridge in San Francisco, and the Thousand Islands Bridge over the St. Lawrence. Early in Mr. Robinson's career (1904 to 1907), he was in charge of the design and construction of the Manhattan Bridge in New York. He had also been in charge of improvement work on the Manhattan Elevated Railway; supervising engineer on the construction of military installations for the Bureau of Yards and Docks during the first World War; and on the engineering board that designed the Philadelphia–Camden Bridge over the Delaware.

CHARLES EDWARD WADDELL (M. '[illegible]) consulting engineer of Asheville, N.C., died on April 20, 1945, as the result of injuries received a day earlier in an automobile accident. Mr. Waddell, who was 67, had for many years maintained a consulting practice in Asheville. As consulting engineer to George W. Vanderbilt for part of this period (1901 to 1931), he designed and built the engineering works at Biltmore. From 1903 to 1923 he was designer and builder of the North Carolina Electric Power Company's system. He was also consultant to many other organizations and to the City of Asheville.

Changes in Membership Grades

Additions, Transfers Reinstatements, and Resignations

From April 10, to May 9, 1945

ADDITIONS TO MEMBERSHIP

APPLE, THOMAS ALEXANDER (Assoc. M. '45), Associate Highway Engr., Public Roads Administration, 1440 Columbia Pike, Arlington, Va. (Res., 4686 Homer Ave., S.E., Washington 20, D.C.)

ARCHER, JOHN SKIDMORE (Jun. '45), Structural Draftsman, B. & O. R.R. Office, Bridge Engr., Baltimore 1, Md.

BANE, RAYMOND DEWEY (Assoc. M. '45), Res. Engr., Sverdrup & Parcel, 1848 Railway Exchange Bldg., St. Louis, Mo.

BARNES, CHARLES RAY (Jun. '45), Ensign, CEC, U.S.N.R.; 2902 Lincoln Way, Ames, Iowa.

BENSLEY, WILLIAM PLETZ (Jun. '45), Bridge Draftsman, St.L. & S.F. R.R., Gen. Office, Springfield (Res., 720 Fairview, Webster Groves), Mo.

BULBA, JOSEPH JOHN (Jun. '45), Structural Draftsman and Designer, Jackson & Moreland, 31 St. James Ave., Boston, Mass. (Res., 370 Fulton Ave., Hartford 6, Conn.)

BULLOCK, ARTHUR DUDLEY (M. '45), Field Engr., Armco Drainage & Metal Projects, Inc., Box 689 (Res., 112 Kensington Ave.), Trenton, N.J.

CARLETON, ROBERT GOULD (Assoc. M. '44), Asst. to Operations Mgr., Africa Orient Div., Pan-Am. Airways, Box 1351, Miami (Res., 149 Ponce de Leon Blvd., Coral Gables 34), Fla.

CLARK, ARTHUR MERRITT (Jun. '45), Maj., Corps of Engrs., U.S. Army, Headquarters, 98th Engrs., Army Post Office 782, Care, Postmaster, New York, N.Y.

COMMANDER, AUGUSTINE CATES (Jun. '45), Structural Designer, Whitman, Requardt & Associates, 1304 St. Paul St. (Res., 3448 Caton Ave.), Baltimore 29, Md.

DAVIS, JOHN TAYLOR (Assoc. M. '45) Structural Engr. and Office Mgr., J. Russell White, 109 State St., Albany (Res., 56 Ely St., Coxsackie), N.Y.

DOLE, CLARENCE RUSSELL (M. '45), Civ. Engr., The Cincinnati Gas & Elec. Co., 323 Plum St. (Res., 3414 Oak Lane), Cincinnati 9, Ohio.

DOTY, GLENN HAROLD (Assoc. M. '45), Asst. Dist. Engr., State Highway Comm., 15 Second St., N.E., Mason City, Iowa.

DRUMMOND, GARRETT BARTLETT (Assoc. M. '[illegible]) Asst. Prof., Civ. Eng., Univ. of New Mexico, Box 120, Albuquerque, N.Mex.

ENGELHARDT, ROBERT LEE (Assoc. M. '[illegible]) Mfg. Engr., Consolidated Vultee Aircraft Corp., San Diego, Calif.

GALE, SAMUEL HAWES (M. '45), Engr. (hydroelectric) P-5, Board of Engrs. for Rivers and Harbors, 2 New York Ave., N.W., Washington, D.C.

GALLI, JAMES HENRY (Jun. '45), 377 Stevens Ave., Portland 5, Me.

GRUNWALD, ALFRED DANIEL (Assoc. M. '[illegible]) Field Engr., Koppers Co., Inc., Box 557, Camden, N.J.

HENDRICK, WILLIAM ARTHUR (Jun. '45), Seaman 1/c, U.S.N.R.; 612 South Washington Ave., Saginaw, Mich.

HOLMES, WALTER THEODORE (Jun. '45), Asst. Engr., Kodak Park Works, Eastman Kodak Co. (Res., 106 Christian Ave.), Rochester [illegible], N.Y.